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SIR WALTER SCOTT
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THE

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THE WIDENING OF THE HISTORY SYLLABUS.

BY PROFESSOR J. W. ADAMSON, KING'S COLLEGE, LONDON.

ANY proposal to enlarge an already quite sufficiently crowded curriculum is certain to arouse suspicion, if not active hostility, in the minds of schoolmasters; and rightly so. One would therefore wish to disarm this particular objection at the outset. The following lines are a plea for such a treatment of the syllabus of historical teaching in schools as will, it is believed, improve the teaching in quality, while not necessarily adding to the burden of teacher or taught. It is the writer's opinion that an accumulation of relatively unimportant details respecting national history constitutes a part of that burden, and that its abandonment would leave room for the inclusion of so much general history as would effect a desirable reform in the study of history in English schools.

Selection of Historical Subject-matter.

Some principle of selection becomes imperative in dealing for educational purposes with matter so complex as history. One of the greatest dangers attaching to an educational course consisting of a great number of branches is that each of these may be pursued with reference chiefly to its own proper end, but with scanty regard to its relations to the curriculum as a whole. The teacher seeks to make his pupils expert mathematicians, fluent speakers of French, sound chemists, and so on, without stopping to consider the relation of fluent French-speaking to a knowledge of chemistry, or of these to the entity called "an educated person." Recent theories of scholastic method as applied to the teaching of science greatly favour this attitude; but all forms of specialisation tend to encourage it beyond measure. The conception of the nature and method of historical study which has guided the historians of our own day to their triumphs, a conception which may be summarised in the phrase, "history is a science of observation," is one which readily suffers the disability in question when introduced into the schoolroom. To the historian *pur sang* the study of history is naturally and rightly its own sufficient end and justification; that the study may have ethical, political, economic, or other special worth in the culture of the student is an entirely secondary or even an unimportant consideration. When the student of history who has been taught in the light of this conception becomes a schoolmaster, he has still to answer the fundamental question, Why include history at all in a school curriculum?

History and History "for Edification."

Perhaps the most commonly stated reply to this question is,—For the sake of good morals; history is a sphere wherein the moral judgment may be exercised, ideals cultivated, the good life encouraged, and warning taken against following what is evil. But, unless kept in check by the historical temper, this view of the educational province of history only too readily leads to the falsification of history itself. Under its influence, human beings are represented as merely incarnate virtues or vices; inconvenient phenomena like wars, or the easy triumph or seeming triumph of might over right, are but superficially touched, where they are not entirely ignored.

History, however, is no museum of labelled, dusty specimens, but rather a bioscope of the many-hued life of the past conditioning the life of the present. The moral value of its study would therefore seem to be of that strictly general and mixed kind which belongs to the study of literature, and to that intercourse with men themselves of which literature is the impressive reflection. We send the youth to the study of history in order to increase and systematise his knowledge of men, to show him Man writ large, very much as Plato describes an ideal commonwealth the better to bring out the essential nature of human virtue. The out-

come of the study is not the easy optimism of the old transpontine melodrama, Vice ever defeated, Virtue always in the end triumphant. Men may differ as to the appropriateness on his lips of the dying words of Gregory VII., "I have loved righteousness and hated iniquity, therefore I die in exile"; the words nevertheless undoubtedly express a truth exemplified time and again in the course of history. If the good never suffered nor failed, there would be no tragedy in human things. "Sunt lacrimæ rerum." The moral function with which the educator invests history is legitimately fulfilled by extending the human horizon of the student; we have not so much to judge the past as to understand it.

While, then, the historian finds his primary object in the historical "facts" themselves, or in the cultivation of historical method, the schoolmaster regards edification of some kind as one of those objects which he seeks to attain by means of historical instruction. There is no necessary incompatibility here between the historian and the schoolmaster. "History for edification" need not mean "cooked" or otherwise falsified history, provided the proper safeguards are frankly applied. But the two different standards of value must unavoidably bring about a difference of proportion and of treatment; periods, events, and persons will not secure the like attention from schoolmaster and historian. For the former's purpose the chief interest gathers about periods when human activity is striking and the moral import is evident.

Stages in Historical Instruction.

A principle of selection must be admitted not only as between the historian and the schoolmaster, but also as between the teacher of children and the teacher of youths. The differences between these in point of actual intercourse with grown men and women, in point of knowledge, emotional capacity, and mental development generally, require corresponding adjustments of aim and method on the part of the schoolmaster. With pupils below the age of fourteen not much really historical work can be undertaken. With boys and girls younger than ten or eleven the practicable aim seems to be limited to stimulating a sympathy with the people of other times by appealing to imagination and to the pleasure experienced in the exercise of that faculty on more or less "picturesque" or "romantic" themes. Children a little older may add to this somewhat desultory learning a knowledge of the great outlines of the national story; the boy or girl of fourteen, whose schooling is to be prolonged for several years, may make a beginning of the study of history. These divisions correspond roughly to facts of mental life. Social conditions demand at least three different types of school course, all depending upon the length of the pupil's school life. Assuming a preparatory stage up to ten or eleven in each case, there should be an elementary school course for the years 11–14, another for the years 11–16, and a third for the years 11–18 or 19, the lines not being sharply drawn at the years named.

National and General History.

But, above all, there is the selection for omission. In any sufficient sense to cover universal history by means of a school programme is not feasible; whether it is desirable need not be considered. The national story is that part of history which best lends itself to wholesome edification, since it is most strongly rooted in the sympathies of the pupil. Accordingly, all official curricula regard history as primarily national history. But the connections between nation and nation are not negligible. In some instances these relationships are best described by the epithet "organic"; in all there is a causal reaction, differences being of more or less only. In other words, the national story ceases to be such whenever the attempt is made to isolate it; when the connections are ignored the story is misrepresented. In such circumstances, world-wide economic movements and principles of intellectual or political freedom, arising out of changed conditions, escape observation, become obscured, or, at most, are thought of as the deeds or opinions of individual men, their causal function being belittled or entirely missed.

Thus official curricula, our own at length included, suggest the association of national and foreign history. "The teaching need not be limited to English or British History" (*Code*, 1906, *cp.* 2). "The aim of the teaching should be to furnish the scholars with a connected knowledge in outline of the main course of English history and a few leading events in the history of other nations which have influenced our own country" (*Suggestions to Teachers*, p. 64). The general aim of the Prussian teaching of history in secondary schools is officially said to be "a definite knowledge in time and place of the epoch-making events of universal history, especially of German and Prussian history, in their association of cause and effect, and development of the historical sense." "History other than German is to be drawn upon so far as it is of importance for the understanding of German history." Owing to causes themselves historical, the French programmes are somewhat more jealous on behalf of the more narrowly national side of history than are the German. Still, even the Cours Supérieur (ages 11–13) of French primary schools includes "very summary ideas of general history: for antiquity, Egypt, the Jews, the Greeks, Rome; for the middle ages and modern times, great events studied especially in their relation to the history of France." The application of the same principle is liberally extended in the historical teaching given in the Lycées and Collèges.

Preparatory Stage.

The nursery and the class-room alike get a hint from the tastes of primitive men, for whom history and literature are indistinguishable; the two studies may be made to spring from common ground. This common basis is the preparatory stage which closes about the age of ten or eleven, its commencement lying in favourable circumstances in the nursery; history and literature mingle, no studied attempt being made at first to separate fact and fable. The chief point on the historical side is to arouse in the child's mind the notion that there were men long ago both like and unlike the men of his acquaintance, ancient men of whose doings it is delightful to hear, whose work may still be traced in the institutions and material fabrics about us. Myth and legend, the almost *natural* substance of early teaching in literature, will be admitted into the course as readily as ostensible matter of fact; and critical scrutiny of the latter will be deferred. There is room both for "Bos locutus

est" and for Horatius at the bridge; after all, the wildest of such stories give shape to the beliefs and aspirations of the men amongst whom they grew up, and in that degree and sense are historical material.

Heroic Tales.

A story belonging to the national history should have first place, provided it has the "romantic," "picturesque," or emotional quality, but more especially if it be a story associated with some historical crisis; yet heroic stories from foreign history bringing the same credentials should also be included. The following may be given by way of illustration; the list is not meant to be exhaustive, nor is it intended for all schools indifferently. If the pupils to be considered continue their education till sixteen (and still more if they do so till eighteen or nineteen) the proportion of foreign history should be greater than if the contrary be the case; the longer the course, the more respect should be paid to the claims of ancient and foreign history. The names, "Hannibal," "Luther," etc., stand for episodes and anecdotes, not for full biographies or histories.

The story of Troy: episodes from the Iliad and Odyssey. Thermopylæ. Salamis. Alexander the Great.

Romulus and Remus, and other Roman stories, as those of Horatius, Cincinnatus (in the latter case not omitting to notice the nickname). Hannibal. Julius Cæsar.

Constantine: *In hoc signo vinces.*

Roncesvalles. Charlemagne crowned by Leo III.

Arthur and the Round Table.

Hengist and Horsa. Beowulf. Caedmon.

The Nibelungen.

Bede. St. Boniface (Winfrith). Alfred. William the Conqueror. Hereward.

St. Francis (as in the *Fioretti*).

"Purple patches" from Froissart: as Sluys, the siege and fall of Calais, Crecy.

Bruce. The Black Prince. Henry V. Joan of Arc.

Sir Thomas More (as in Roper's *Life*). Luther. Raleigh.

Charles I. Cromwell. William III.

The Forty-five.

Frederick the Great. Clive. Wolfe. George Washington.

Nelson. Wellington. Napoleon. The Indian Mutiny. Queen Victoria.

The elementary school would probably make a very restricted use of Greek or Roman history as sources for this, or indeed for any part of its course in history. The inclusion of Biblical instruction in the school curriculum is here assumed; some parts of Biblical history might be expressly included in the history syllabus, as is suggested in the French programme already quoted.

Method at the Preparatory Stage.

The method during this preparatory stage would be almost entirely oral, as best adapted to the anecdotic and pictorial treatment contemplated. The stage being one which combines the teaching of history and literature, free use should be made of English writing which is not altogether over the heads of young boys and girls. Lamb's *Adventures of Ulysses*, the versions of the old Greek stories made by Kingsley and Nathaniel Hawthorne, Macaulay's *Lays*, Malory, the historical plays of Shakespeare, some of the narratives in Hakluyt (many have been made accessible in Messrs. Cassell's *National Library*), all offer themselves for the purpose. Whether extracts should be read to the pupils by teachers or class-mates, or whether the children should be sent to books to read for themselves, or the teacher alone should tell the story, paraphrasing such writers as those named, are questions admitting different answers. Each of the measures named might very well be employed in favourable circumstances; the teacher alone can determine what these are. Mrs. Beesly's *Stories from the History of Rome* is a book which furnishes a good model of the kind of teaching required, except that pictures should be liberally provided, though it is best to have these elsewhere than in the book used as a text. Before the end of this preparatory stage, an outline of the national story should be commenced.

English and Foreign History.

Between the ages of ten or eleven and fourteen a closer approach may be made to real historical study than was possible to younger children. Where school life is to terminate at the last-named age, subject-matter must chiefly be derived from the native annals; where schooling is prolonged beyond it, the leaven of foreign history may be stronger. The illustrations which follow are meant to suggest the kind of association between national and general history which these two classes of pupils should form, each in their degree. Obviously, the pupil with the more time can carry these associations the further, while the pupil whose time is short must restrict himself to those connections which have been accompanied by the greater and more enduring consequences. But amongst the illustrations are some of which neither kind of pupil should remain ignorant.

If the school course begins with the Roman invasions of Britain, the opportunity arises of pointing out that these at length brought this country within the Roman system, and the significance of the fact should be developed as fully as the pupils' ignorance and immaturity permit. If the national story is made to begin in the middle of the fifth century, the English invasion should appear as one of the episodes of the barbarian conquest of the Roman Empire. It is better that boys and girls should have some knowledge of these cardinal events, than that they should remain ignorant of them because their attention is riveted upon the several stages of the Roman or English conquest of this island.

In the early history of England, the conversion to Christianity and the attacks of the Northmen are seen quite out of perspective when they are portrayed as purely English events. The former clearly calls for recognition as a token of the missionary zeal of Gregory the Great, who added Spain and Lombardy to the Roman fold also, and established the temporal power of the Popes. The raids of the heathen pirates from Scandinavia in the eighth century are but early manifestations of that renewed activity of their race which later threatened to overwhelm the Frankish Empire. While it is necessary to make the pupil realise how great was the danger with which England was threat-

ened by these marauders, the point is more likely to be taken if he sees them also now upon the lower Rhine, now besieging Paris, then uniting for the conquest of England, and barely hindered from effecting their purpose by Alfred, again doing the like in Central Germany, sacking Charlemagne's own city of Aachen less than seventy years after his decease, establishing themselves in Normandy. Similarly, the Normans' conquest of England demands a reference to the doings in the eleventh century of that pushful race of Northmen in Sicily and Southern Italy, where, beginning their career as mercenaries for (or against, as the turn served) the "Greeks" of the Eastern Empire, they made themselves masters in spite of orthodox Christians and Mohammedan Saracens, strengthened the temporal dominion of the Papacy, and so helped to make the political unity of Italy an impossibility down to the other day.

Again, the unfilled bishoprics of the time of William Rufus and his investiture dispute with Anselm are not explained (as in so many of our school-books) by representing them as merely the tricks of a grasping king or the personal quarrels of a virtuous ecclesiastic and an ill-living monarch. Even the schoolboy can understand that these things are in principle a repetition of that secular strife between Henry IV. and Gregory VII. which found its dramatic moment at Canossa in 1077. So, too, our Henry II. and the recalcitrant Becket are but reflecting in a small mirror the greatest of all mediæval political phenomena, the struggle of Emperor and Pope for the mastery of Christendom.

The doings of Wat Tyler and his comrades are a symptom of economic change and stress which is displayed also in contemporary or almost contemporary French and Flemish mob-violence. So, too, the Wars of the Roses are the English analogue of the strife of Armagnac and Burgundian, and of the civil war of the *Bien Public*. Alike in France and in England, decentralising feudalism was resisting to the utmost the opposing force constituted by those nationalist movements which were then bringing modern times to the birth. The hours asked from the schoolboy for a study of the battles of the Wars of the Roses, "with dates," would be better spent in the contemplation of these great facts of the century between 1380 and 1480. The details of the struggle between Red Rose and White may be left to the professed student of history and to the competent local historian, from whose hands they may pass, revivified, to the schoolroom.

At many points in modern history the connection between events at home and abroad is too obvious and indeed too essential to be ignored in a school-book, though the foreign history in some manuals wears a casual or an obtrusive appearance. Yet granted a fairly general recognition of the reciprocal character of European and British history within the modern period, even here a suggestion or two might be offered. For example, the story of the Reformation remains, in not a few text-books intended for school use, too much a thing of ecclesiastical partisanship. As a bare matter of fact, the causal relation of events which hinge upon the Church history of the sixteenth century is very complicated, and the period is, on other grounds, not well adapted to the schoolmaster's aim of edification. Would it not, then, be an improvement to abandon the partisan attitude and the attempt to "edify," while calling the pupils' attention to certain broad streams of fact, such as the political and personal aspect of the earlier English movement against papal supremacy, and the influence of Zurich, Basel, and Geneva upon many minds in England and Scotland? Persecution brought about the intercourse of English refugees with a very militant type of ecclesiastical revolutionary abroad, whose ideas fell upon congenial soil; the later policy of Elizabeth forced a compromise upon Catholic and Calvinist (or Zwinglian) which never became a settlement, as the subsequent ecclesiastical history of this country testifies. Older pupils may well be invited to note these things, and to contrast them with the course of events in the German or French reform movements.

Or, again, to take a later period: the associations of British and Continental history during the eighteenth century are not easy to miss. Nevertheless Seeley's *Expansion of England* was regarded as setting these in a most instructive and even a novel light. It would be rash, however, to assert that that light is now universal in the class-rooms, though it began to shine nearly a quarter of a century ago.

Any teacher who may suppose that the association of national and general history by means of an outline or by selections must necessarily be either trifling or jejune when addressed to junior pupils, will do well to examine a set of reading-books called *Gateways to History*, which Mr. Edward Arnold has published. The taste and skill of the author of these charming books have been worthily seconded by the publisher, and the outcome of their joint labours ought to convince the sceptic of his error.

Course in General History.

It remains to consider the syllabus for scholars above fourteen, who include amongst their studies some universal history, as such, in addition to the national history. Taking the latter into account, the whole may be spread over a three (or four) years' course; in other words, only pupils whose stay at school extends materially beyond sixteen could take such a course in any fulness. But much may be done in any school where the leaving age is above fourteen, if the principle of selection be judiciously employed within the limits of the national story. For example, much time might be saved, if some of the detail of small profit concerning minor campaigns, truces, and treaties were omitted; and although the English history will embrace some notice of the development of the liberty of the individual, constitutional history may be ruled out as too specialised a study for schoolboys.

Not much time, if any, need be given to the prehistoric, or to any civilisation older than the Greek. The former is not history, and, at present, the reconstruction of the latter is too uncertain in point of detail for the schoolroom; lessons on the Old Testament will afford sufficient opportunity for such casual references to ancient Egyptian and Western Asiatic life and culture as are desirable and possible. European civilisation is very largely the development of Greek and Roman thought, tempered by Christianity, and the principle of selection which has been adopted above sanctions the omissions here suggested. The following somewhat bald catalogue is offered in illustration of the landmarks and leading topics of general history which may be fittingly included in a syllabus such as that under consideration.

I. Greece.

Physical geography: city-states: colonies. The Athenian empire, democracy and culture: contrast with Sparta.

Philip of Macedon: Alexander and his conquests. Greek civilisation in the East.

II. Rome.

Legends of early Rome criticised. Conquest of Italy, of the Mediterranean basin. "Captured Greece takes captive her rude conqueror." Roman administration. Breakdown of senatorial government. Julius Cæsar. Augustus. The *Pax Romana* and the conception of the World-state.

III. The Roman Empire and the Church.

Constantine. Rome and Constantinople. The Barbarian invasions. Benedict (480–542) and his Order. Gregory the Great (590–604).

Mohammed: rise of the Arab power and beginning of the Eastern question. For more than a millennium (633–1683) the Mohammedans continued to menace the Christian States, sometimes merely raiding, sometimes effecting permanent conquests. (This is one important aspect of European history concerning which the school-books say little, and that little often fails to assign to the Crusades their proper place in mediæval thought and action).

IV. The Western and Eastern Empires.

Charlemagne. "From him, in whose deep mind the whole theory of the world and human life mirrored itself, did mediæval society take the form and impress which it retained for centuries, and the traces whereof are among us and upon us to this day" (Bryce).

Break-up of the Frankish Empire (*circa* 843). Northmen, Saracens, Magyars, Slavs threaten the Eastern and Western Empires. Synod of Constantinople (866) separates Eastern and Western Christendom.

V. The World-Church *v.* The World-State.

Otto the Great: Barbarossa. Feudalism keeps down the non-Christian foes outside the Empire, but at the cost of excessive decentralisation tending at times to anarchy: *e.g.* England in Stephen's time.

Study of Civil and of Canon Law: Scholasticism: rise of Universities. The Friars.

Avignon the Papal Seat (1305–78): the Great Schism.

VI. Renaissance and Reformation.

Florence and Venice as palmary examples of the Italian city-state. The Renaissance. Fall of Constantinople and end of the Eastern Empire, 1453. Maritime discovery, 1486, &c. Break-down of Feudalism in face of the spirit of Nationalism.

Charles V. and Philip II: Luther: The Jesuits and the Counter-Reformation: Council of Trent: Calvin: Wars of Religion.

VII. Modern History.

The New Philosophy.

Thirty Years' War. The Revolutions of 1648 and 1688. Louis XIV.

Prussia becomes a kingdom. Frederick the Great. Prussia *v.* Austria. England *v.* France in India and in North America.

The United States of America constituted.

The French Revolution.

Napoleon.

The Congress of Vienna.

The undoing of the work of that Congress: as exemplified in 1830 (Belgium and Holland), 1866 (Sadowa), 1870 (Hegemony of Prussia and Kingdom of Italy), 1905 (Secession of Norway).

Method and Text-books.

In the preparatory stage the teaching is entirely oral, and it is largely oral where pupils are under fourteen; but the older boys and girls for whom such a syllabus as the foregoing is suitable must learn to work by themselves. One profitable way of so working consists in expanding outlines traced by the teacher, or in following up clues or hints given by him. This opens the question of text-books and books of reference. The choice of the former in general history for the pupils is not great. Freeman's *General Sketch of European History* contains so much in a small space as to be unsuitable for use as a book to which pupils may go in the first instance; the same disability attaches in a less degree to his little volume on Europe in the *History Primers*, but here the pruning-knife has been used to better effect. Both books, however, might be employed to summarise teaching previously given at greater length and supplying a background or "atmosphere." Myers' *General History*, a book of nearly 800 pages, opens with a chapter on the Eastern Nations (India, China, Egypt, Chaldæa, etc.), and brings the tale down to the present; Harvey Robinson's *History of Western Europe*, a book of about the same size, begins before the Teutonic invasions. Both works are very liberally supplied with maps, portraits, and pictures, a matter for gratitude in the present scarcity in our schoolrooms of such indispensable aids to the study of History. But they add materially to the cost of these two well-written and handsomely-appointed American text-books.

Mr. Arthur Hassall has quite recently published *A Brief Survey of European History from Charles the Great to the Present Day*, which admirably meets the requirements of the type of book we are seeking. The great stages of the story are made to stand out free from over-much detail, while tables of dynasties and of genealogies help the reader to preserve the thread in those labyrinths which must occasionally be entered. The lists of authorities placed at the end of each chapter constitute a good bibliography, English, French, and German, most serviceable to the student of history. The book contains less than 400 pages, including a very useful analysis of contents, an index of proper names (the absence of which would be a very grave defect in such a book), and a dozen maps; the omission of pictures is entirely excusable.

Atlases of maps illustrating the course of general history *ought* to be in the hands of the students; at this moment, however, the teacher must consult the foreign bookseller for these, the English supply not existing. A more serious adverse criticism on our mode of teaching boys history can hardly be found. Directly the demand for such things becomes effective (and it is the teachers' business to make it effective) British publishers, one may be certain, will hasten to meet it. Meantime, there is the exceedingly popular

and cheap *Historischer Schul-Atlas* of Putzger, published by Velhagen and Klasing, Leipzig, which within the range of nearly 250 maps and plans covers general history, ancient, mediæval, and modern, in a manner sufficiently complete for school purposes. The current edition is the twenty-ninth, and its price is three shillings. The same author and publishers have given us a more elementary work, suited for junior forms, in their *Kleiner Geschichts-atlas.*

Only one or two reference books for the teacher's use and for the school library can be named here. Gibbon's *Decline and Fall*, in Prof. Bury's edition, and Mr. Bryce's *Holy Roman Empire* (the latest edition is of the current year), are taken for granted. *The Periods of European History*, in eight six-shilling volumes, under Mr. Hassall's general editorship, form a good conspectus of the long period outlined in the syllabus which is exemplified above. The *Cambridge Modern History* is on a scale rather too big for our purpose; and its story practically begins in the late fifteenth century. Mr. Gooch's *Annals of Politics and Culture* (from 1492) is a particularly valuable manual for the teacher of history.

Apparatus.

The cuckoo-cry that school instruction is "too bookish" has inflicted a double mischief on such studies as history. On the one hand, it has been held to sanction an expenditure, sometimes extravagant, and nearly always one-sided, in favour of studies wrongly deemed independent of books, while it has also encouraged the opinion that little or no apparatus is required for the purposes of literary instruction. Educational authorities, who are ready to build laboratories and to furnish them handsomely, supply no reference books for the use of teachers or senior pupils, while they eschew all text-books except the lowest-priced.

As a matter of fact, the schoolmaster who is teaching history needs a good deal of apparatus. Some of it he can best make for himself, in the form of tables and other devices meant to catch the memory through the eye; some of it lies about him in monuments, public buildings, and museums. But these last are not generally accessible, and they are seldom of such a nature that they can be made to illustrate all the periods and localities of universal history. What is needed is, in effect, a museum, extensive, comprehensive, and *portable;* in other words, a very large collection of drawings exhibiting *in an authoritative form* (*i.e.* in reproductions of contemporary pictures and other works of art) the everyday life of former times in different European lands, men's amusements, arts, tools, arms, costumes, buildings, whether singly or in such groups as the precincts of castle or cathedral, the street of the town or village. To be adequate, the number of these pictures must be great; the ordinary text-book has no room for them, and space fails for storing wall-pictures in sufficient quantity. Lantern-slides best solve the problem, or would do so, once they were made. Such collections of pictures are part of the equipment of the foreign teacher of history, and many examples will be found in French and German catalogues. Perhaps the most notable is the *Album Historique* of Lavisse and Parmentier (Colin, Paris), in four volumes, each containing between 1500 and 2000 pictures and a small stream of explanatory letter-press; the work costs sixty francs in all, but volumes are sold separately. The educational authority which made such a collection easy of access to teachers and pupils would do much for the advancement of historical instruction in schools.† Meantime, teachers and pupils who are not so favoured must seek such authoritative illustrations in the volumes of Traill's *Social England*, or in Green, or in such earlier works as those of Charles Knight.

Amongst wall-pictures which are suitable for the teacher of general history one may name Lehman's fine series published by Messrs. Philip, illustrating the progress of civilisation. The Art for Schools Association has given us a notable set of historical portraits. On the principle of deferring the stage of criticism, the pictures employed in the preparatory course may be of the kind which aims at impressiveness rather than historical or archæological accuracy. But when purely historical teaching is the object, such accuracy is important; and the works specified are based on that rule.

BY MANY HANDS.

"Quot homines, tot sententiæ."

THERE has recently been issued by the Board of Education a *Report of the Consultative Committee upon Higher Elementary Schools.** The Board's letter of reference to the Committee, dated 6th July 1905, stated that the "special problem of difficulty" in connection with the Higher Elementary School is "the determination of the nature and amount of that special instruction which marks it off from the upper part of an ordinary Public Elementary School." In order to arrive at sound conclusions the Committee wisely took the evidence of five employers of labour among others on the general question. It is this which gives to the Report its chief interest, and a good deal of its significance as an educational document. From Kindergarten to University, our teaching institutions have for long been out of touch with real practical life. And after all, what is the function of the school but to show the child "how to make a living and how to live"?

* * *

WHAT is the testimony of these employers of labour? "They have been unanimous in the opinion that boys and girls entering their service should possess habits of discipline, ready obedience, self-help, and of pride in good work for its own sake, whatever it may be." "Habits of mind are far more important than any particular knowledge or degree of attainment." "The characteristics that employers most

* Price 6d. from Wyman and Sons, Fetter Lane, E.C., or Oliver and Boyd, Edinburgh.

† Messrs. Lavisse and Parmentier have also edited a small album for pupils (*Album Historique: Le Moyen Age*) containing nearly 400 pictures; the price is about two shillings. Both it and the large work begin with the fourth century.

value would appear to be *general* handiness (which is really to a large extent a mental quality), adaptability and alertness, habits of observation and the power to express the thing observed—accuracy, resourcefulness, the ability to grapple with new and unfamiliar conditions, the habit of applying one's mind and one's knowledge to what one has to do."

IT follows, therefore, that there is no desire on the part of the employers for technical instruction of any kind—that is a matter for a later stage in the pupil's development. They would be more than satisfied if those who seek employment under them were to begin their work equipped with a good general education. "I do not advocate," says one witness, "including any of the things in the school curriculum which the boy would afterwards have a better opportunity of learning in his handicraft or in his employment." "I would not specialise in any way," says another, "but always have in view the development of the faculties of the boy in the best possible way to enable him to perform his work and to learn his trade on entering upon an occupation to gain a living." This rules out book-keeping, which "cannot be taught from a text-book," as well as shorthand and typewriting, which are grouped under "definite trade training," all of which appears to us to be good, sound, common—or shall we say uncommon—sense. It is the obvious method to draw illustrations of any given subject from the pupil's environment, but this is not the same thing as definitely preparing a school to enter a local chemical factory *en masse*.

AS for manual training, we cannot do better than quote the answer of an inspector who was asked, "In the case of children *being prepared for industrial work*, would you not give a good deal of manual instruction?" "I should do that in *all* cases," was the truly broad-minded and educational reply. One wonders whether the witness did not add, "You have no right to say that your pupils are being prepared for anything but intelligent citizenship." Even the finest of our social products ought to have hand and eye duly and efficiently trained.

THE fourth chapter of the Report deals with the "Character and Extent of Present School Provision," and is the most important of all. Here it is not difficult to see the policy of the Committee, which will doubtless become that of the Board of Education. It is, in short, to sweep into the "Higher Elementary" field the old Higher Primary Schools, the Higher Grade Schools, so called, and the "Lower Secondary" Schools, including among the last-named "Higher Grade Schools converted after the Cockerton judgment into Secondary Schools," in which the third and fourth years are so often woefully attenuated.

LET the "Municipal Secondary" School, therefore, look to its third and fourth years. "A Secondary School that tries to be what it is called, and yet cannot induce the majority of its scholars to remain beyond the age of fifteen, is prevented from concentrating its energies to the best effect, and from realising its name, because its energies are distracted and dissipated in the attempt to provide at the same time for pupils who will only go a part of the way, and get less than proportionate part of the benefit to be derived from the complete course. The course of instruction, however good in itself, cannot possess its full value, because the pupils do not stay long enough. Thus, such a school is apt to give only a fragment of a higher type of education, and to devote time to the study of subjects that cannot, in three years, be studied properly, bearing in mind the plan upon which the Secondary School draws up its curriculum, and develops its methods of teaching."

THIS is, in the main, incontrovertible. We think, however, that the Committee and the Board spoil their case by the way they set about the work of organisation. There is urgent need in our educational system for an Intermediate School standing between the Primary Grade and the true Secondary School, which retains the bulk of its pupils up to the age of eighteen; and this class of school ought to be provided with a preparatory department with fees of about £2 per annum. But let the authorities and their advisers spare themselves the trouble of deciding what social class the pupils of this Intermediate School are destined to adorn. The pupils counted fit to pass from the Primary School to the Intermediate School will be in very many cases quite able to hold their own with those who have had a slightly different origin, and will indeed, as has been proved, add an element of virility to any school into which they are drafted. Let the Board also drop the term Higher Elementary, which is not only tactless but entirely meaningless.

TO the broad-minded educationist there are three classes or castes in the body politic. There are the Capable, who are to a great extent independent of conventional education, and whose capability "will out" no matter what social class they spring from; the More or Less Capable; and the Incapable. And the double aim of his work is to keep out of the way of the first class, and to increase the number of the second at the expense of the third.

IN discussing the establishment of the Higher Elementary School the Committee devote particular attention to the rural districts, and their solution of this problem is a recommendation to imitate the Scottish plan of organising Supplementary Courses. Choose a central school, and give it a Higher Elementary "top," only be very careful of arousing jealousy between schools with "tops" and schools without them. The tender solicitude of the Committee is very touching. By this means we may even check to some extent the exodus into the towns! When will some one in authority finally lay this bogey and relieve Whitehall of the solicitude which must be ageing some of our officials long before their time. The exodus into the towns is a matter of economics, not of sentiment. But apart from this, there appears to be sound sense in the Committee's recommendation, which will possibly be adopted.

N.U.T. NOTES.

VISITORS to Scarborough will readily recollect that, after an interesting—not to say exciting—discussion, Conference empowered the Executive to appoint a Secretary to the Examinations Board at a salary not exceeding £250 per annum, "the post to be open to members of the Union." Considering the exceedingly modest stipend, the somewhat remote possibility of substantial increase, and the exacting and responsible character of the duties laid down, it was eminently gratifying to the Executive to see so large a response to their advertisement for the new official, fifty-five ladies and gentlemen making application for the appointment. They ranged in age from six-and-twenty to forty-four, and 'mongst their many and diverse qualifications were those represented by the letters: B.A., B.Sc., M.A., F.C.S., L.L.A., F.R.H.S., F.R.G.S., F.E.I.S., Mus. Bac., A.C.P., F.C.P., F.I.P.S., and F.R.Met.S., to say nothing of a "Barrister-at-Law." Professional experience had been gained in many quarters, the candidates including head and class teachers in primary schools, heads of commercial day and evening schools, language and science masters, coaches, training college lecturers, heads and assistants in secondary schools and P. T. centres, clerks in education committees' offices, and in business houses. An almost microscopical examination of credentials was undertaken by a small committee, and then nine gentlemen were requested to meet the full Executive. Each candidate was invited to state, in three minutes, his views on the future development of the Examinations Board, a sufficiently severe test to be "sprung" upon him, and so well did each acquit himself that selecting the right man became even more difficult. After a series of some five or six ballots, the appointment fell to Mr. W. Hollingsworth, B.A., a trained certificated teacher, who has been for the past seven years on the staff of the Manchester Pupil Teachers' College, and a lecturer in the evening certificate classes conducted by the Manchester Education Committee. He is already *au courant* with certain portions of the Board's work, being examiner in French and in English (for foreign centres), and is both ready and willing, if desired by the Board, to conduct examinations in History and Mathematics, subjects for which he holds special qualifications. Mr. Hollingsworth has borne a worthy part in all movements for professional advancement, and acted as Secretary of the Manchester Certificated Class Teachers' Association for six or seven years. His high organising ability was splendidly proved by the magnificent success of the Manchester Conference of the N.F.A.T. (1900), of which he was General Secretary. An old and intimate friend of mine describes him as "enthusiastic, tactful, gentlemanly, and thoroughly reliable," and with his immense capacity for work, first-rate abilities, and capital business faculties, Mr. Hollingsworth will more than justify the high hopes now confidently reposed in him.

The Examinations Board's New Secretary.

JOHN STUART MILL must have been gifted with almost prophetic foresight when, in that marvellously uneven essay, *On Liberty*, he deplored how, even in his day, politicians of every hue vied with one another in converting the subject of education into "a mere battlefield for sects and parties, causing the time and labour which should have been spent on educating, *to be wasted in quarrelling about education.*" And yet one would fain hope that the titanic struggles of the past decade have not been altogether fruitless, but that a healthier public opinion concerning *the thing* itself will be ultimately and universally developed throughout the country. The discussions on the 1902 Bill, noteworthy in many respects, brought the position of the teacher with startling vividness before Parliament; and when, in fulfilment of a Government pledge, the Code article: "The teacher shall not be required to perform any duties except such as are connected with the work of a Public Elementary School, or to abstain, outside the school hours, from any occupations which do not interfere with the due performance of his duties as teacher of a Public Elementary School," was introduced, it was hoped, with some confidence, that the palladium of the teacher's individual liberty had been, at last, secured. The happenings, however, in the metropolis, during the past few months, have caused considerable unrest and uneasiness; and although what the *London Teacher* terms "the ill-fated experiment" is now at an end, it cannot be gainsaid that the attempt of certain busybodies connected with the L.C.C. to make the teachers of a few schools responsible for the supervision of children during the dinner interval leaves a bad impression behind. No section of the community—not excepting even the professed philanthropists—does more in the way of organising, developing, and carrying on all kinds of beneficial work for the welfare of the children than their teachers, who constantly devote much of their well-earned leisure towards getting their little charges fed, and clothed, and adequately shod. If, however, their philanthropic labours are to be made quasi-compulsory, their grace and glory vanish, and enthusiasm speedily disappears. After all, the teachers exist and are paid *to teach—not* to serve out soup, and officiate generally as a kind of *arbiter elegantiarum* at the scholars' dinner-table. There is no need, in these columns, to urge the necessity for proper rest and refreshment after the morning session, so that the teachers may be fit, mentally and physically, to complete their professional day's work: but I do protest against any conditions of service which savour of personal degradation, and these must altogether dissolve when the Sustentation Fund of the N.U.T. attains reasonable proportions.

Extraneous Tasks.

WITHIN a month of the appearance of this paragraph, the advance-guard of those five hundred teachers of both sexes, "including professors, head masters, head mistresses, assistant teachers," in fact all grades of public instructors, from the university to the primary school, will have set sail for America, under the ægis of Mr. Alfred Mosely, C.M.G. In these days of short memories, it may almost be necessary to record the fact that this gentleman, in 1903, invited a number of representative educationists, including Mr. Harry Coward, at that time President of the N.U.T., to form an "Educational Commission" to the U.S.A.; and the result of their investigations was published in

A Trip to America.

a volume which may still be had by any one willing to forward cost of postage (fourpence) to the Co-operative Printing Society, Tudor Street, London, E.C. As most of the Commissioners were in a comfortable position socially, it was perhaps in accordance with the "fitness of things" that the *entrepreneur* should defray a considerable portion of their personal and travelling expenses; and doubtless their lucid and illuminating reports would render him well satisfied with his expenditure. The "five hundred" will bear their own expenses, Mr. Mosely's action, if I understand aright, being limited to negotiating with steamship companies for special terms for the visitors, and enlisting the sympathies and good offices of our old friend, President N. Murray Butler, head of the Columbia University, New York, in order to prepare itineraries for the British visitors, and furnish them with particulars of what to see, and how to set about it. Local committees have been formed to meet the travellers on arrival and conduct them to quarters previously secured, and of moderate cost, although I have my doubts concerning the kind of accommodation procurable at "about 6s. 3d. per day." I am not so greatly impressed as certain of my colleagues with the "generosity" of the steamship companies in conveying the investigators to and from America for the sum of £5; for from November to March—the period during which only these terms are available — the liners are doubtless run practically empty. The generosity of the British authorities which have granted leave of absence, on full pay, to those in their service, appeals to me much more. In wishing them *bon voyage!* I trust they will return home all the better equipped to perform their duties efficiently, as a consequence of expending their employers' time and their own money.

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"Quarterly Notes."

THE Teachers' Provident Society in connection with the N.U.T. continues to advance in prosperity by leaps and bounds, and great must have been Mr. Arthur Golding's satisfaction at being able to chronicle in the current issue of *Quarterly Notes*:—

Invested Funds exceed . .	£215,597
Annual Income exceeds . .	£65,000
Total Membership exceeds . .	15,200

His object is "3000 new members for 1906," and with a strong and united effort on the part of all local officers *and existing members*, this number should be easily secured, seeing that 1457 had already been enrolled in little over six months. Quite one of the most encouraging features of the Society's work is the sympathy invariably extended by the Principals of the various Training Colleges, who never hesitate to commend the T.P.S. to the outgoing students. From the latest *brochure*, I learn that all Friendly Societies are having the same unpleasant experience, viz. that the sickness of the present year amongst their members is greatly in excess of that of the last few years; and, with the absence of any special epidemic, the explanation is not particularly easy to determine. The Grand Master of the Oddfellows has, however, propounded the suggestion that "the sanitary laws and hygienic conditions under which people now live conduce to longevity, and it is a well-known principle in Friendly Society work that sickness advances with age, therefore a larger amount of sick pay is drawn by the older members than in former years," and doubtless there is "something in it." Miss S. E. Jobson (member of the N.U.T. Executive and the Provident Board) in an interesting paper on "Thrift and Insurance for Women," quotes a significant statement by Mr. A. W. Watson, F.I.A., to the effect that women are more liable to sickness than men, especially from twenty to forty years of age. "During this period, the amount of sickness is 50 per cent. higher for women than men; but at sixty years of age women have *less* sickness than men, the proportion being less than three and a half weeks per year for women, but more than four weeks per year for men." I thoroughly agree with the proposal made by a Local Secretary that the words "Teachers' Provident Society" should be henceforth omitted from all wrappers and other papers open to inspection, despatched to members. I can understand the *raison d'être* of names of business firms being prominently displayed on all covers used by them; but personally I always squirm, and register a slight mental protest, when I receive communications with the names of professional organisations printed across them. *Verb. sap.!* Is the editor of *Quarterly Notes* a serious candidate for the prize "howler"? I ask this simple question, on account of his description of the Finance and General Purposes Committee as *the most important Committee of the Union.* Oh! Mr. Golding!!

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Mr. A. S. Caudle for "V.P."

AT one of the interminable discussions of the "Special" Committee appointed in such hot haste by the Scarborough Conference to consider Finance, Reorganisation, and apparently every other Union matter that cannot be dealt with under these two headings, I happened to make an innocent reference to the reluctance of the majority of the present Executive to intervene in Conference debates, especially when things were a bit critical or "awkward." I was literally amazed at the sceptical incredulity displayed by most of my hearers, who were evidently, and honestly, of opinion that nothing *could* stem the oratorical propensities of the Union's Cabinet. Whether they or I hold the correct view matters little; but I venture to say there is one gentleman from whom all Conference *habitués* would gladly hear more, viz. my excellent friend Mr. A. S. Caudle, the latest aspirant for Presidential honours. Since the introduction of the Electoral Districts *régime*, this popular Reading teacher has worthily represented South England, being returned top of the poll, if my memory serve me correctly, at each of the nine elections he has fought and won. For several years he has held the position of under-study to that genial veteran and Union Nestor, Mr. G. J. Rankilor, Chairman of the Organisation Committee, where his great abilities have barely had sufficient scope. Possibly he finds some consolation in the circumstance that, year by year, he is chosen one of the Executive's representatives on the "B. and O." Council, the work of which is particularly congenial to a man of his great heart and ready sympathies. Visitors to Llandudno will never forget the delightful way in which he seconded a vote of thanks to the retiring President, in a speech the veritable antithesis of that which fell from the lips of

the brilliant and epigrammatic Mr. A. R. Pickles, B.A. Mr. Caudle will, in fact, be ever acceptable to any audience, for he possesses the saving grace of humour, in addition to a clear and forcible conception of the necessities of the occasion. At the Reading Class Teachers' Conference of 1902, he distinguished himself under most difficult and delicate conditions, and although he is not so well known as some of his friendly rivals, he will undoubtedly "arrive." No elector need hesitate a moment about casting his or her vote in Mr. Caudle's favour. A. C.

NOTES FROM THE NORTH.

FROM the Report of the Committee of the Privy Council on Education in Scotland we note that there has been during the year a most gratifying increase in the number of scholars on the registers of schools under inspection—namely, 1·34 per cent., with an increase of 2·07 per cent. in the average attendance. The percentage is the highest that has ever been attained, and stands at 86·60 per cent. Of the 804,162 scholars on the registers, 696,381 have been present each day, thus leaving 107,781 absent every time that the schools were open, as against 101,223 out of 793,492 last year. The number of children over fourteen years of age this year is 22,815, as against 22,519, a state of matters which seems to indicate that the people of Scotland are desirous of giving their children a good education. The number of Higher Grade Schools or Departments is steadily increasing, so that this year there are 121 of these as compared with 74 in the preceding year. In these schools there were on the registers 14,420 pupils, as against 9927 last year; and the average attendance is 14,508, as compared with 10,107 in the year before. The number of certificated teachers has increased from 12,801 to 13,604, a proportion of one certificated teacher for every 52 children. The average salary of a schoolmaster (whether principal or assistant) is now £151, 7s. 6d.; that of a schoolmistress £77, 8s. 8d. Last year the figures were respectively £149, 12s. 7d. and £75, 17s. 5d; so that while the male teachers show an increase of £1, 14s. 11d., the increase for the mistresses is £1, 11s. 3d.

Education Statistics.

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TO the Report a most instructive chapter has been added on the question of the supply of teachers. This, no doubt, is the Department's reply to the discussion in some quarters with regard to the shortage of supply. It is stated that the proportion of qualified teachers to the average number of children might with advantage be improved, especially as regards the supply of certificated trained teachers. Indications are not wanting of a tendency towards improvement in this respect. But when it is noted that in Higher Grade Schools the number of pupils allowed for each teacher is thirty, and in supplementary classes forty, there must in not a few schools be teachers with classes far in excess of the number permitted by the Code. This, of course, is not as it should be, and the Department does well to call attention to the fact that there is room for some improvement. Another point that should not be lost sight of in calculating the number of pupils to each teacher is the fact that owing to the increasing number of large schools the headmasters cannot be counted on the staff. I am strongly of opinion that the Department take too rosy a view of the staffing in the schools of Scotland, and am convinced that the majority of teachers still have very large classes to deal with.

Teaching Power.

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A COMPARISON with the figures of the preceding year shows the number of certificated teachers actually employed to have increased by 803, whilst the number of Article Seventy-niners, or ex-pupil teachers, has remained stationary. The increase in average attendance during the same period has been 14,112, of which 4491 are in Higher Grade Schools. If we take 30 as the number for staffing in the latter case, we find 150 teachers are needed in the Higher Grade Schools, while 215 are required for the other schools; so that of the increase of 803 no fewer than 365 are required for this increase in average attendance, leaving 438 to be accounted for by the more liberal staffing arrangements adopted by school managers. Careful inquiry as to the cause of teachers leaving the service has been made in all cases where teachers have relinquished their appointments, and a summary is given of this inquiry for the year 1905—so far as teachers who are not known to have taken up fresh engagements in Scotland are concerned. We find that the number this year is 574 (718). Of that number 201 (268) have been married (parenthetically, it may be observed that this does not seem to have been such a good marrying year), 72 (98) have left owing to ill-health, 53 (53) have died, 39 (46) have retired owing to age, 30 (47) have changed their profession, 22 (37) have gone to South Africa, and 61 (83) have invaded England. I have given last year's figures in brackets for the sake of comparison. In connection with the English invasion, it may be interesting to note that no fewer than 36 teachers who have completed their training this year have obtained appointments in England. These are not included in the previous numbers.

Losses to the Profession.

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A SUB-COMMITTEE of the Institute has for some time been considering the advisability of establishing a fund to provide for the dependants of members. Careful inquiry has been made, and as a result a very exhaustive and interesting report has been prepared to be submitted to the annual meeting in September. To the Convener, Mr. Allan Arneil, Glasgow, the thanks of the Institute are especially due, as on his shoulders has fallen the greater part of the work. This duty he has performed with great thoroughness, and evidently with keen enthusiasm. It is to be hoped that the subject will receive the attention it merits.

Institute Dependants' Fund.

I may give the two most important conclusions here:—

"Provision by men and women against permanent breakdown in the form of a supplement to the breakdown allowance of the Government on the friendly society plan up to 65 years of age, or by endowments and annuities payable at an earlier age, or a combination of both, should be considered."

"The Committee are of opinion that a small beginning could be made with a scheme providing sick-pay benefits on the Holloway or N.U.T. Provident plan

(Deposit Scheme), and if that proved successful a larger scheme could be instituted. Both sexes would be eligible for membership, but to secure the equitable working of the fund it would be advisable to have separate branches for men and women."

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Institute Benevolent Fund.

THE Institute some years ago started a Benevolent Fund for the use of its members. The income of the fund is obtained by a levy of one shilling per member. The funds at 2nd July 1906 amounted to £1779, 1s. 4d. During the past year grants have been made in twenty-two cases, amounting in all to £407. Four widows received £100; four men teachers £95; and fourteen women teachers £212. As the income for the year was £409, 3s. 10d., it was practically exhausted by the grants made. The number of applications during the last year showed a large increase, and to judge from the number already received, a greater number may be looked for in the current year. If the average grant given in the past year is to be maintained, it is evident that an increased income will be required. As the main object of the fund is to provide temporary relief to needy members, widows, and orphans of teachers, it is plain that applicants cannot expect from the funds amounts which can only be looked for from friendly societies, at a far higher charge to each individual than one shilling per annum.

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Institute's Finances and Membership.

THE finances of the Institute for the year ending 30th June 1906 show a very gratifying increase. The income for the year amounted to £1596, 0s. 3d., while the expenditure for the same period was £1280, 4s. 9d., so that a balance of £315, 15s. 6d. falls to be carried to the capital account, which, excluding the £1779, 1s. 4d. mentioned above, now stands at £5748, 16s. 10d. There have been added during the past year to the membership 994 new members, so that the membership of the Institute must now reach nearly 10,000. Most of the branches show a very decided increase for the year, the largest increases being Ayrshire 101, Edinburgh 105, Fifeshire 75, Glasgow 220, and Hamilton 77; while some of the smaller branches show a proportionately larger increase. Glasgow's membership now stands at over 2000, while the membership of Edinburgh approximates to 1000. When it is considered, however, that there are 13,604 certificated teachers, it will be seen that there is still a considerable number outside the fold of the Institute. Perhaps the greatest number of non-members is to be found among the lady teachers.

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E.I.S. Doings.

DURING the past few months the Committees of the Institute have been giving careful consideration to the question of direct Parliamentary representation. The Parliamentary Committee, which has had the matter specially under review, thinks it would be necessary (1) to raise a Parliamentary election fund of, say, £2000; and (2) to levy an additional special subscription of, say, 2s. a member. Another subject that has received attention is the reduction of the number of the General Committee of Management. R. D.

THE BRITISH ASSOCIATION AND NATURE STUDY.

IN 1903 the British Association appointed an influential committee to inquire into and report upon the curriculum of the Primary School. The report of this committee was presented to the Association by Sir Philip Magnus at the York meeting of the present year, and we give below that portion which is concerned with the teaching of Nature study. The subcommittee which dealt with this branch of the school curriculum consisted of Mr. R. H. Adie, Miss L. J. Clarke, Mr. A. D. Hall, Mr. Hugh Richardson, and Mr. Harold Wager.

The Object of Nature Study.

We regard the direct study of Nature as a sound foundation for all training of the observing and reasoning powers, and we consider that it is a subject particularly suited to elementary schools under present conditions.

Of the many subjects available for Nature study we regard the study of the living plant from the experimental side as most suitable for elementary schools. It satisfies the following important requirements: (i.) It can be made experimental, and most of the experiments are such as can be repeated by the pupils. Some experiments are of a continuous character and afford training in measurement and recording. It is wise to emphasise the quantitative side of many of the experiments. (ii.) The subject forms a connected series of lessons, the later work developing naturally out of the earlier. (iii.) The experimental teaching in school is easily linked to the outdoor life of field and hedgerow with which country children are familiar; it naturally introduces observations on animal life, soils, the weather, &c., and it is readily illustrated by practical examples drawn from the work on the garden and on the farm, so that the children learn that school work may have a bearing on their after life.

The development of Nature study finds a natural starting-point in the object lesson.

The Object Lesson.

(*a*) *The Objects Set.*—Several teachers of repute have recently drawn attention to the cycle of the seasons as the best ruling idea for the arrangement of any scheme of Nature lessons. And this we heartily endorse; there can be no better guarantee that the teaching will really be based on observation and experiment. In summer there is endless material. In winter it is more difficult to realise the opportunities of the moment; but the long nights favour the study of the stars, the bare earth suggests the study of soil and rock, the weather is always a source of anxiety, the frost without and fire within suggest lessons on heat and cold.

The teacher who is planning his lessons some months beforehand will therefore require a calendar indicating what topics are likely to be in season. Gardener's calendars are given away as advertisements by several firms of seedsmen. The current *Whitaker*, or, better still, the *Nautical Almanac*, gives warning of impending celestial events. The average time of flowering of wild plants has been observed and indexed under the heading "Phenology." Several naturalists' calendars have been published. A farmer's year-book will be useful in the country. From these and from his own

experience a teacher can compile a calendar of possible topics from which to choose his lessons.

(*b*) In this connection we append a *Nature Study Calendar*.

JANUARY.
Trees; twigs, branches, bark. Evergreens.
Snow. Ice. Frost.

FEBRUARY.
Bulbs, corms, tubers.
Catkins.
The lengthening day.
Flooded rivers.

MARCH.
Development of birds.
Seeds and seedlings.
Wind. Equinox. Spring tide. Full moon.
View from hill-top. Making maps.

APRIL.
Opening buds.
Rain. Clouds.
Flowers. Migrant birds. Birds'-nests.

MAY.
Experiments on plants. Rate of growth.
Development of hens' eggs in incubator.
Insect life. Bees.
Dew.

JUNE.
Experiments on plants. Assimilation.
Butterflies.
Pollination of flowers.
Longest day. Solstice.
Haymaking.

JULY.
Plants.
Caterpillars.

AUGUST.
Heather.
Chrysalis.

SEPTEMBER.
Harvest.
Seeds and seed distribution.
Equinox. Shortening days.

OCTOBER.
Fruits. Germination of seeds.
Falling leaves. Rain. Rivers.
Planets and constellations.

NOVEMBER.
Fog.
Stones.

DECEMBER.
Snow. Ice. Frost.
Solstice. Shortest day.

(*c*) *The Method.*—The object must be present if the lesson is to be real, and the supply of material must be liberal. If the elephant can only be represented by a picture, that is a reason for giving lessons about something else until it is possible to adjourn to a menagerie. Where flowers or stones are required let them be provided in sufficient quantity to give every child a specimen. Let these be distributed at once, so that the children may start with their own observations. This will require training, and the teacher will at first spend much time in discussing what is seen with the children.

A good way of ensuring that children do really observe is to ask them to make drawings from the specimens in front of them. Drawings can be more rapidly corrected by the teacher than written accounts; but written accounts should also be asked for. If the first attempts of the class are disappointing the teacher may put his drawing on the blackboard before them, then rub it off, and ask them to try again from the specimen, but while the drawing is being done there ought not to be any sketch on the blackboard which might serve as a guide.

The dictation of notes and the copying of diagrams from books or from the blackboard we condemn. We think that a good deal of time is now being wasted on dictation and copying, to the great prejudice of the name and fame of Nature study. The children should be asked questions before they are told the answers; and their verbal answers may be used to draw up a description of the object before them. Afterwards they may try to do the like for themselves.

For the younger children the topic of the object lesson may very well be chosen from those available at the time, and the lesson may be used as a training in the construction of sentences embodying their observations. Children may be encouraged to make their observations in turn.

For the upper standards teachers will rightly wish to plan some more systematic course. But the plan should retain some elasticity in order to fit with the season. If the different stages of the opening chestnut bud are to be watched, they must be seized almost to a day, and yet one year they may open a fortnight before or after their date on the previous year. If the natural order *Rosaceæ* is being studied, we must remember to gather roses while we may.

In training a class to manipulate experiments it is a good plan to ask children in turn to come up and try to do things before the class. In this way interest is stimulated, attention is drawn to probable mistakes, and the teacher feels when the class is ready to start individual work.

(*d*) *The Syllabus.*—We have no syllabus to offer: there is no old syllabus to which we wish to adhere, nor any new one which we wish to put in its place. Any teacher who wishes for a syllabus will find that plenty of good ones have been published already by the Board of Education, and any teacher who has found the spirit in which to study Nature will be able to make a better syllabus for himself, new every year. Salvation will not come by any syllabus; and of every syllabus we would say: "This syllabus must be regarded as suggestive only, and not inclusive. Every teacher should be free to take part of the syllabus in detail rather than the whole superficially, and free also to go outside the syllabus. A syllabus may be useful as a humble servant, but it is a very bad master."

The danger of a syllabus is lest the general topics prescribed, such as types of fruit, inflorescences, shapes of leaves, should be studied in advance of the real concrete plant, whereas all the work should be done from the actual living specimens. The pupil himself, if possible, should carry on the experiments. At all times plants should be studied as living things and not as dead material. So too with physiography, the syllabus should be illustrated by perpetual reference to the school district—indoors by experiments, out of doors by walks and excursions in the neighbourhood.

The Supply of Material.

This must be abundant, in good condition, and sufficiently uniform in character for class teaching. The last condition is not always fulfilled when the children collect for themselves, and when classes are many and large the teacher may find the quantity required too heavy to collect himself. Botanical material is not expensive when compared with the apparatus or chemicals deemed reasonable for chemical laboratory work. Education committees might arrange with nurserymen for wholesale prices, and then ask teachers to order direct on special forms with suitable limits for expenditure, *e.g.*, not exceeding one penny per pupil per hour. The Kyrle Society's action has been most welcome, and the Committees of Public Parks can greatly assist.

Outdoor Work.

While plant life forms a very generally suitable indoor subject for elementary schools, there should be a good deal of flexibility about the nature of the accompanying outdoor work. With some teachers gardening, with others field botany or geology, forms the accompaniment. The teacher should be encouraged to develop a speciality according to his own tastes and the advantages or restrictions of his locality. Thus for a school among osier beds the natural history of the willow is an admirable subject.

It is now within the power of all elementary teachers to take the school out of doors for a lesson and to count

it in the time-table. Inspectors are sympathetic, and it is frequently done.

Every syllabus that includes the shadow of a stick at noon or the nightly turning of the Great Bear about the Pole prescribes topics which it may be impossible to teach practically in lessons held at 2.30 in the afternoon. But this is just the reason why the routine of school work may suitably be broken to allow children to witness exceptional natural phenomena—a great flood, a high tide, or an eclipse of the sun—phenomena whose times of occurrence are not within our control.

In schools which possess a garden much can be done by the children. Simple experiments in assimilation, pollination, grafting, etc., can be tried. Where classification is studied the making of order beds by the children is a great assistance. When it is impossible to work in a garden experiments may be carried on in window-boxes.

Excursions should be made to lanes and fields at all times of the year. Even in towns it is possible to study the branching of trees and unfolding of buds and to become familiar with the aspects of different trees in winter, spring, and summer.

To give definiteness to outdoor work some questions to be answered may be set before starting a walk, and answers to them written out afterwards.

Is it not possible that some city teachers, anxious to gain in Nature lore, would find that a few years spent in working at a country school would give them invaluable opportunities of studying things in the open which previously they had only heard of in lectures or read about in books?

The extent to which the children of the city may be usefully and economically transported to the country for purposes of education remains largely unexplored. The Sunday schools have demonstrated the possibility of taking large numbers into the country for a single day's outing. The Children's Country Holiday Fund and the various seaside camps held during the summer show how to arrange for a few weeks of holiday.

These arrangements have in view chiefly the great need for fresh air and holiday. But of definite, directed educational use of the country we hear little as yet. The question of extending the advantages of a country boarding-school education to the children of the poor is coming up for discussion. One large city is already casting longing eyes on the country school-houses standing empty during the holiday weeks whilst the town children pine for fresh air. A good deal might be done by hearty co-operation between city and county educational authorities. Schemes are mooted for sending out whole classes of city children under their own teachers for a few weeks at a country school. Some voluntary help and organisation, with special funds subscribed *ad hoc*, will probably be necessary to carry these schemes through.

We hear of one London Board school taking its scholars far afield, and a provincial Board school has shown what brilliant use may be made of the school-journey. Some of our secondary schools are emphatic as to the usefulness of such journeys lasting more than one day. In Switzerland they have a much more recognised place as a part of general education. In our own elementary schools the difficulties are largely financial.

Collections.

The collecting instinct is sufficiently strong at the ages we are discussing. The collector is often a naturalist in embryo; he is, therefore, to be judiciously led into the paths of progress. In certain directions—notably bird-nesting—restraint more than encouragement may seem necessary; but numerous recent books illustrated by photographs of birds'-nests show the possibility of teaching children to watch without destroying. The general line is to wean a boy gently from mere collecting to collecting with a purpose; to collecting and observing, and then to the collection of observations in a note-book kept for the purpose. Collecting is a great help to accuracy of observation, and the boy who brings back a collection of pebbles from the seashore or of grasses from a hayfield will know far more about what he carries in his hand than a schoolfellow who has never troubled to pick up anything. Children may be encouraged to try how many different sorts of wild roses they can find along a country lane, and to write notes on their differences.

The collecting instinct is a great motive power, if rightly directed. It should be used to solve special problems. And if prizes are offered they need not be for the largest or best collection of wild flowers, but for collections illustrating insect pollination, or seed dispersal, or climbing plants.

Defects in the Present System.

The sub-committee desire to express their cordial recognition of the efforts of the Board of Education and of the Board of Agriculture to encourage real science work, and they are also aware that much excellent Nature study work has been and is being carried out, but several serious defects have been found, among which we note:—

(i.) An attempt is made to cover too much ground; hence experiments and measurements are shirked because they take time and involve preparation on the part of the teacher. Experiments are described instead of performed, and a drawing on the blackboard takes the place of realities. This is the commonest and most vicious defect in such teaching.

(ii.) Unsuitable subjects are often taken, especially with the idea of being practical. It is no use dictating notes on haymaking to a class when there is no opportunity of taking part in the process.

(iii.) On the other hand, there is a great lack of system. A lesson on opening buds is followed by one on tadpoles or on the motions of the moon. The topics are all in season in March, but for upper standards we think the course should become more systematic.

(iv.) When a definite course is chosen it is often overloaded with classification. The teacher seems to have the fear of a possible examiner before him, and is afraid to omit anything. Science is too often supposed to consist of big words. "Amaryllis, fruit, a bilocular loculicidal inferior capsule," need not appear in the note-book of a boy of thirteen.

(v.) Gardening should never degenerate into the mere employment of cheap child-labour on the teacher's garden without consideration of its use to the child. The criterion of suitability should be the educational value of the subject, and how far it can be made to develop the child's mind.

(vi.) The size of the class is a most important consideration if we wish the children themselves to carry on experimental work. Experience points to from twenty to twenty-four pupils doing practical work in a laboratory as quite enough for one teacher. With larger classes the teacher has to arrive at a compromise

between experiments done by each individual and experiments done by the teacher for demonstration, and the size of the class, if too large, makes it difficult to organise any work of a new character—anything different from sitting at desks, listening, answering in chorus, writing from dictation, learning by rote, or working sums of a monotonous character; in fact, the limitation of the size of the class should be regarded as one of the educational reforms at present demanding attention.

(vii.) A teacher is generally called upon to teach such a great variety of subjects that it is not reasonable to expect him to be an expert in each. Teachers should be encouraged to take as special subjects whatever they can do best.

The Training of Teachers.

These defects would be largely obviated if the training of teachers in the subject could be made more systematic. At present there are four kinds of agencies at work: (*a*) Saturday classes, (*b*) summer meetings for existing teachers, (*c*) the training college course, (*d*) teachers' Nature Study clubs. A general elementary science course which includes some botany is now compulsory in the training college course. Nature study, gardening, &c., can be taken as special subjects in the second year. Not many training colleges took up the subject in 1903, and even those were much discouraged by the magnitude of the work involved in the syllabuses which were attempted. In our judgment every training college should give such instruction in the method of observation and experiment that the future schoolmaster would be put on the right track, and could later on work out his own subject. Teaching may be wholly opposed to the spirit we strive to inculcate if Nature study is treated as another, and a very cumbrous, subject to be got up for examination. The training college student is very heavily taxed; he does not need more subjects; he does need to be taught the right method of going to work.

The more training in scientific research the teacher has had the better. If he has only been getting up book-work in the hope of passing examinations his influence may be less helpful. Where the teacher is not in sympathy with scientific methods of inquiry he cannot be expected to see how to put the children on the right road. It is important that the instruction should not become stereotyped, and a course for teachers will gain in freshness if worked out anew each year. Great insistence should be laid upon the laboratory and outdoor work, and all knowledge should be derived from the study of actual specimens. Mere text-book learning in the training college is like poison at the fountain-head.

Voluntary Help.

Those who are not naturalists by hobby may do much to encourage children by giving their moral support to the simple interests of the wayside. Children may be encouraged to bring curiosities with them to school. Many schools now have a rack of bottles to receive wild flowers picked on the way to school; a slate reserved for Nature notes, where the first scholar who sees a swallow may enter the fact. Pots of growing seedlings may occupy the window-sills. Aquariums are always interesting, and a caterpillar-cage might be tried.

We hesitate to say much about school museums, unless they are to be annually burnt. Their use is in the making, not in the keeping. The course of instruction should be based upon specimens which may be handled freely, and, if necessary, pulled to pieces. But there is great use in a small glass case where objects brought in by the scholars may be placed at once and where every one may see them. This would become a "collection of instructive labels illustrated by appropriate specimens." But not for long; the contents must be changed more often than a shop window if interest is to be maintained.

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For boys over fourteen, attending a secondary school, ready to do some evening preparation and coming from homes where the cost of books is not too overwhelming, the answer would be different; but the caution that their first introduction should be to the living object is then even more important. We do not suppose that at the ages of twelve to fourteen children can usefully be set to learn lessons from any book which has not previously been explained to them.

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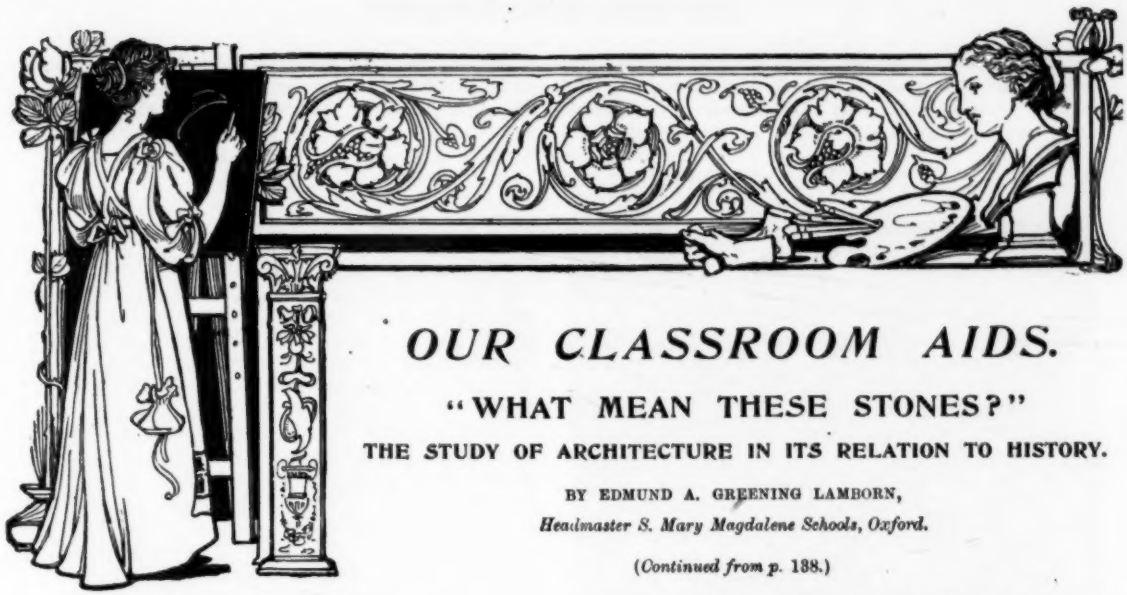

OUR CLASSROOM AIDS.

"WHAT MEAN THESE STONES?"

THE STUDY OF ARCHITECTURE IN ITS RELATION TO HISTORY.

BY EDMUND A. GREENING LAMBORN,

Headmaster S. Mary Magdalene Schools, Oxford.

(*Continued from p.* 138.)

THE ROMANESQUE STYLE.

SAXON AND NORMAN ARCHITECTURE.

The Outward Visible Signs (*continued*).

THE NORMAN STYLE, 1090–1190 A.D.

THIS period represents the time of the development of Western Romanesque from the rude Saxon style of the previous half-century, till it loses its identity in the Early English or First Gothic style. Development is seen all through the period, but especially in the latter part of it, when the returned Crusaders had brought from the East ideas of ornamentation borrowed from the Eastern Romanesque or Byzantine buildings which they had seen in their travels.

Norman masonry is exceedingly massive, the walls being of great thickness, as may be observed in the window splays, and the pillars short, but of great girth. This is partly due to the fact that they are constructed of rubble, with a facing only of ashlar. The mortar at first was bad, and the joints between the stones are sometimes an inch or more in thickness. In the early stages particularly, strength and solidity were secured, not by the accurate fitting of the parts, but by piling up great masses of masonry. The buttresses are of little use as supports, being wide and flat, and only projecting about six inches from the face of the wall. They were probably not intended for structural effect, but were designed, like the Classic pilaster strips, to break up the monotony of the wall surface. In late Norman work small shafts are carved on the corners of the buttresses. In the photograph of Iffley Church (Fig. 29), a plain flat buttress, *c.* 1160, may be seen south of the chancel, while at the south-east corner is a Transitional buttress with shaft, *c.* 1190.

Norman roofs were of moderate pitch, higher than the Classic roof masks, but lower than the Gothic. The arches, of course, are round, and the doors are deeply recessed, the windows widely splayed and small, especially in the earlier stages. They are not divided into lights by mullions, but sometimes, in late work, a pair are placed side by side under a single arch. Sometimes arcades of blind arches, corresponding to the windows, are carved on the wall surface, as may be seen at Christchurch, Hants, and the intersecting arches in these arcades may have suggested the lancet window and the pointed arch. The string-course —a projecting band of stone which runs round a build-

FIG. 29.—A Norman Church, Iffley, Oxon. The chancel affords a study in buttresses. The middle one on the south is Norman (1160), the corner one with shaft is Transitional (1200), those on the east are Early English, as are the windows which have been inserted in the Norman walls (1220), and the pair on the south are late Early English or Early Decorated (*c.* 1300). The Norman corbels under the battlement should be noticed.

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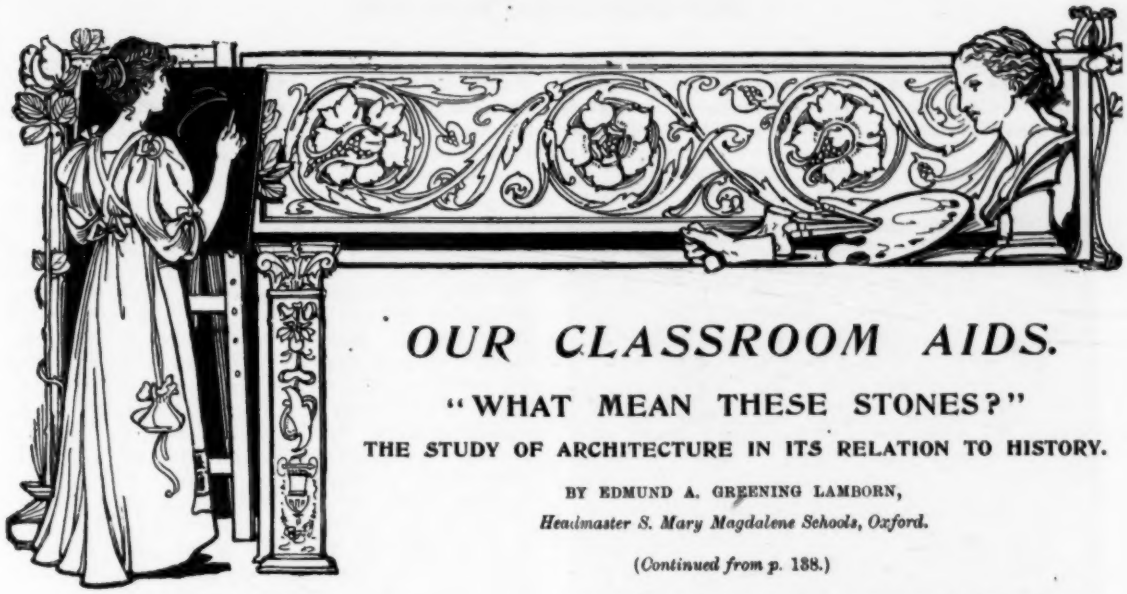

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Norman roofs were of moderate pitch, higher than the Classic roof masks, but lower than the Gothic. The arches, of course, are round, and the doors are deeply recessed, the windows widely splayed and small, especially in the earlier stages. They are not divided into lights by mullions, but sometimes, in late work, a pair are placed side by side under a single arch. Sometimes arcades of blind arches, corresponding to the windows, are carved on the wall surface, as may be seen at Christchurch, Hants, and the intersecting arches in these arcades may have suggested the lancet window and the pointed arch. The string-course —a projecting band of stone which runs round a build-

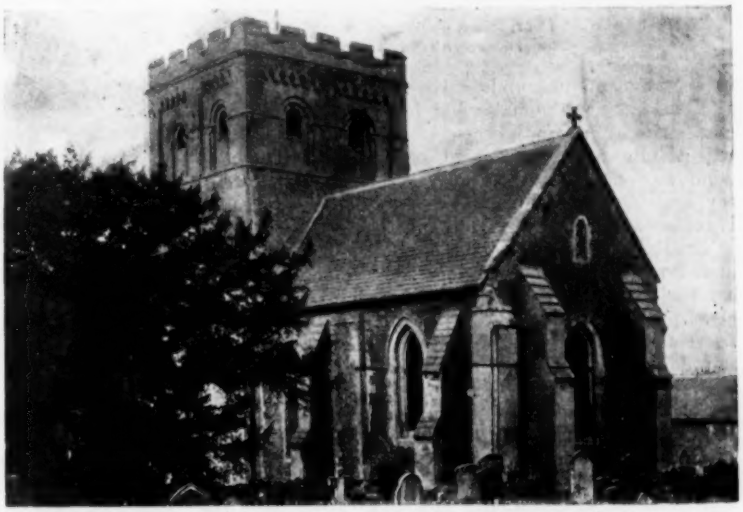


FIG. 29.—A Norman Church, Iffley, Oxon. The chancel affords a study in buttresses. The middle one on the south is Norman (1160), the corner one with shaft is Transitional (1200), those on the east are Early English, as are the windows which have been inserted in the Norman walls (1220), and the pair on the south are late Early English or Early Decorated (*c.* 1300). The Norman corbels under the battlement should be noticed.

ing at the level of the windows, and which sometimes follows the curve of the window-head, forming the "label," "hoodmould," or "dripstone" above it—is very heavy in the Norman style, usually semicircular

FIG. 30.—West Door, Iffley, showing zigzag moulding, beak-heads, and signs of the Zodiac.

in section, and not undercut. Above the west door and below the west windows of Iffley Church, the Norman string-course may be seen, and may be compared with the lighter Early English string over the chancel windows. Sometimes, as at St. Peter's, Oxford, Romsey, and Christchurch, Hants, the plain string-course is replaced by a line of billet-moulding.

The lines of carving on the jambs of doors and windows are known as mouldings. Norman mouldings are varied, and, especially in late work, are used with great profusion. The most common are the zigzag or chevron moulding (see west door of Iffley, Fig. 30); the billet moulding, square and round; the rose moulding, the cable, the chain, the nail-head, and the pellet.[1] A very common enrichment in early work is the hatched moulding, formed by simple hatchet strokes.

Doorways, especially, are elaborately ornamented with these enrichments, and rich ones often have recesses in the jambs containing shafts. In a few cases the heads of the doorways are trefoiled, though this is more common in the succeeding style. Often the head is square, and the semicircular space above, between the lintel and the arch, called the tympanum, is filled with sculpture. A splendid illustration is to be seen at Hanborough, Oxon. A remarkable enrichment used on some doorways and, rarely, on chancel arches, is the beak or cat-head ornament. Grotesque heads of birds or cats, with long projecting beaks or tongues, are carved on the arch and jambs, as on the west door of Iffley (Fig. 30). There may be seen, too, a chain of ovals containing what appear to be the signs of the Zodiac, forming, in this case, the dripstone of the arch.

Chancel and tower arches are often enriched with the same mouldings as the windows and doors. At Wimborne Minster, Dorset, the arches of the nave arcade are also enriched with mouldings. More frequently, however, interior arches, as at Bicester (Fig. 28), are quite plain. The piers of the tower arches are usually square, often with square recesses at the angles containing shafts. The capitals of these shafts, and of those in the jambs of doors and windows, are of the form known as the cushion capital. Sometimes, as at Iffley, scenes of war or the chase, reminding one of the figures on the Bayeux tapestry, are carved on these capitals. The piers of the nave arcade are generally round, sometimes square, with half-columns on the faces. They stand on massive square plinths, as in the Classic style. The capitals are sometimes cushion-shaped, and sometimes of the form known as the scallop capital, which is simply a cushion capital with flutes carved on its under side. The abacus is square, its lower edge is often chamfered off, but its upper edge is always square. There are often volutes at the corners of the capitals, as in those of the Classic Ionic order. Sometimes these volutes resemble knobs of unopened foliage, forming, as it were, the buds from which the beautiful foliage of the succeeding style was to develop.

The plan of the Norman church, like that of the Byzantine one, was cruciform, with nave, chancel, and

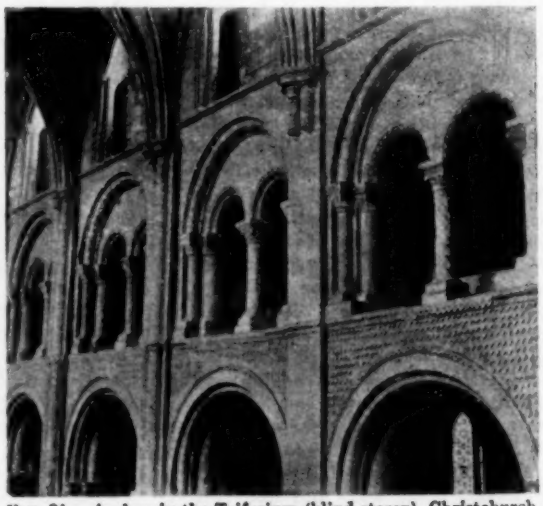


FIG. 31.—Arches in the Triforium (blind storey), Christchurch, from east, showing billet ornament on the easternmost arch, and axe work on the walls.

transepts (in small churches like Iffley the latter were sometimes omitted); but a central tower, the flat roof of which could be used for military purposes, was built instead of the dome, and the nave or western arm of the cross was longer than the other, while in

[1] Strictly speaking, all these are enrichments of the mouldings, rather than mouldings themselves: the true mouldings being the rounds and hollows on and in which they are carved. These, in the Norman style, are very few and simple, and for the purpose of this article the enrichments may be considered as mouldings.

Byzantine churches the arms are equal in length. The Norman chancel was round-ended (apsidal), but most of them were subsequently modified to the square east ends of the Gothic style.

The Romanesque Style.

The Inward, Spiritual Meanings.

We will proceed to consider how far it is possible to trace a correspondence between this earliest architecture of the English nation and the nature of the men who developed it. In the first place, it was a derived style in its main principles, and we find evidence of this in the round arches, square plinths, thin buttresses, and apsidal chancels. We find further evidence of the lack of original architectural power in the cruciform plan and some ornamental carving, which were borrowed from the Byzantine builders. But, tracing the development of the style for the hundred years of its existence following the Conquest, we find in all the other details of the ornamentation the story of a continuous growth of independence and national self-assertion. The characteristics of the race show more and more in the building, till at last, with the invention of the pointed arch, the last trace of the Classic models passes away, and a national system of architecture grows naturally out of the borrowed style.

The civilisation of the English (Saxon and Norman) of the twelfth century was far inferior to that of the nations from whom they borrowed their architectural principles. They were nearer "the untutored mind" of the savage. So there is a barbaric splendour about their decorative art. The beak-heads with which they ornamented their doors are evidence of the superstitious imaginations of untutored minds. They were intended to represent evil spirits lurking with outstretched beaks to pluck away the pious thoughts from those leaving the church. The rude sculpture of stricken knights and rearing horses, of boars at bay, and wild beasts fighting are evidence of the warlike spirit and sports characteristic of the age. These are the only natural decorations. But though the ornamentation is mainly conventional, there is none of that unvarying precision about it which reflects the iron law of Greek and Roman civilisation. The Norman workman is clearly not a slave. He has not many more mouldings than the Greek slave, but he varies their combinations infinitely. None of his doorways or windows match—unless he places a pair of the latter in obvious contrast. The carvings on his corbels vary; his gargoyles are dissimilar and grotesque. He uses the Classic volute, but he transforms it into a sort of knob of opening foliage (in the following period the knob does open, as will be seen). In late work all his capitals vary in ornamentation. So even at this early period we see the signs and growth of that desire of change, that love of variety, that spirit of restlessness and longing which is the most essential characteristic of the English race, and which gives to the Gothic style that variety which is its predominant characteristic also. It is the spirit which has impelled the English race to spread itself over the face of the world, which has led it to discard old shibboleths and seek new truths, and to find no rest but in progress.

There is another racial characteristic reflected in the details of the Norman style, which, like the spirit of changefulness, is seen more clearly in the succeeding one. We spoke just now of the profusion of ornament to be found in late Norman work as the style grows more and more towards naturalisation. The workman decorates his jambs and lintels with moulding upon moulding, filling every available hollow with his rude carving, and decorating with his growing skill the ruder work of the previous generation. The carving in a late Norman church, such as Ilfley, represents years

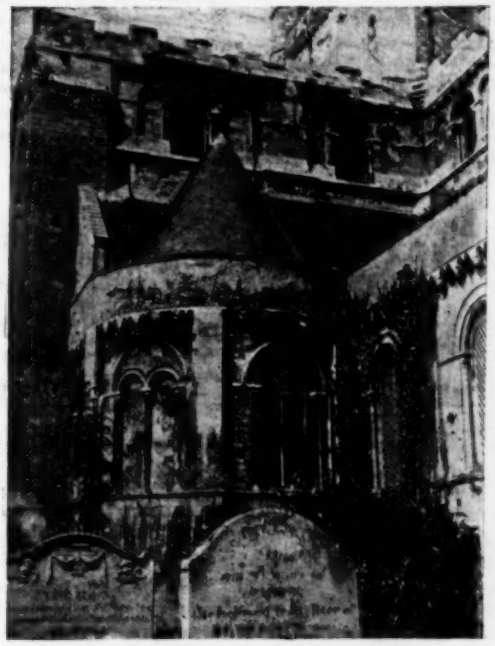


Fig. 32.—Norman Apse, Romsey Abbey.

of patient toil. Any one studying it with insight must see in the workman that spirit which has made the English race what it is. That which his hand found to do the Norman workman did with all his might. Enthusiasm for his work, ungrudging labour, indomitable perseverance, these are the lessons the British workman of to-day may learn from the handiwork of his Norman predecessor.

The host of Nature-lovers who have availed themselves of "The Wayside and Woodland" series of pocket handbooks to the wild flowers and trees of this country, will be glad to learn that Messrs. Frederick Warne & Co. announce for immediate publication a new volume in the series, dealing with "The Butterflies of the British Isles." This is the most complete work in a small compass that has yet been produced on this subject. Mr. Richard South, F.E.S., the well-known editor of *The Entomologist*, is the author, and he has supplied a popular description and life-history of every native species, together with practical instructions in collecting and preserving the insects. The coloured plates have been produced by photography from the actual butterflies, and are a triumph of the printer's art. They include figures of the male and female, the upper and under sides, and all the more important variations of each species. In addition, there is a similarly complete set of black and white plates giving the egg, natural size and enlarged, the caterpillar, chrysalis and food-plant of each species. Mr. South's reputation among entomologists is a guarantee of the absolute trustworthiness of this handbook; and the beauty and fidelity of the plates should make this one of the most popular volumes in a popular series, of which Mr. Edward Step, F.L.S., is the general editor.

COURSE OF LESSONS IN DOMESTIC SCIENCE AND HYGIENE.

THE SENSES.

ALL knowledge of external things must be obtained by means of the five senses: sight, hearing, smell, taste, and touch. As a matter of fact there is a sixth sense—the muscular sense—which enables us to judge the weight of a given body by estimating the amount of muscular exertion required to support that body; although not usually included among the senses, it is clearly a means of gaining knowledge of external objects, and, like the other senses, it can be developed and improved by constant practice.

A. The Eye.

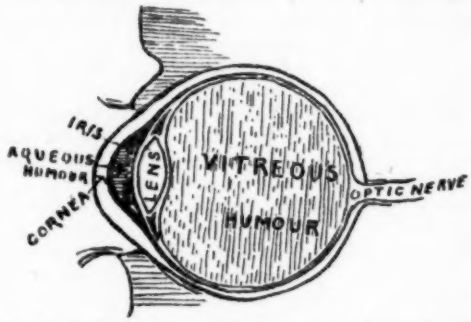
Step I. Preparation.—The eye is an optical instrument, dependent on the laws of light precisely as a camera does. Those children who possess a camera will be familiar with its structure and action, but for those who have not it would be advisable to show the formation of an image by means of a convex lens, noting (1) that the image recedes as the object approaches the principal focus of the lens; (2) that the image is inverted.

Step II. Presentation.—In shape the eye is nearly globular, slightly bulging out in front. A section will disclose the fact that it consists of two chambers, a very small one in front filled with a watery substance, called on that account *aqueous humour*, and a larger one behind containing a jelly-like substance, the *vitreous* or *glassy humour*. Between these two is suspended a transparent lens-shaped body—the *crystalline lens*—in front of which is suspended the *iris*, an exquisitely beautiful circular curtain, the colour of which varies in different people. From the back of the eye the optic nerve carries the image to the brain, and in order to receive that image the end of the nerve is split up into a layer of nerve tissue, which forms quite a network at the back of the eye, and is therefore called the *retina* (a net).

As the eye so closely resembles a camera in structure and action, the two might be compared point by point:—

Association.	*Presentation.*
1. The camera consists of a box with opaque sides and an opening in front to allow the light to enter.	1. The eye is enclosed in a tough case, known as the *sclerotic*, which is opaque everywhere except in front, where, without changing its essential character, it becomes transparent, and is called the *cornea*.
2. The inside of the camera is painted a dull black to minimise reflection from the sides.	2. The inside of the eye is lined with another coat having a layer of cells containing a black pigment.
3. In the opening in front of the camera is placed the lens, which forms the image.	3. The crystalline lens is situated behind the transparent cornea.
4. The amount of light which enters the camera is generally regulated by means of a circular plate pierced with a number of holes of varying size. (There is also a diaphragm on the market, which, by an ingenious arrangement of eccentrics, regulates the size of a central aperture.)	4. The *iris* performs the same function for the eye. It consists of a circular curtain with a round hole, the *pupil*, in the centre, and is provided with a number of circular and radiating muscles which contract and relax automatically in order to adjust the size of the pupil to the intensity of the light.
5. The inverted image formed by the lens is received on a sensitised plate at the back of the camera.	5. The inverted image formed by the crystalline lens is received on the retina, and is conveyed by the optic nerve to the brain.
6. As the distance of the image from the lens varies with the distance of the object, the proper "focus" is obtained by screwing the lens backward or forward until the image falls on the plate.	6. The eye is "focussed," not by altering the position of the crystalline lens, but by altering its convexity; when looking at distant objects the lens is less convex than when the eye is focussed on things near at hand, in which case the lens is compressed laterally so that it becomes thicker in the middle.

There are many interesting points connected with the eye which could be touched upon did time permit, such as the blind spot, the effect of colour on the optic nerve, the persistence of the image, which enables us to throw a second image on the retina before the effects



of the first have disappeared, thus producing such effects as the so-called "moving pictures," etc., but we must pass on to the means taken to protect the eye from injury. Such a delicate organ as the eye needs great protection, and when speaking of the skull we saw how the bony socket shields the eye itself from a blow; then the eyebrows prevent perspiration rolling down from the forehead into the eye, while the eyelids with their fringe of eyelashes keep dust and insects from entering the eye. Any minute particles of dust that enter the eye in spite of these precautions are washed out by a fluid which is secreted by a gland situated in the outside corner of the eye; this fluid, assisted by the movements of the eyelids, washes the eye and then runs off by a tiny duct or opening leading to the nose. In times of grief this fluid is secreted faster than the duct can carry it off, and so runs down the cheeks in drops or "tears."

Step IV. Formulation.—1. The eye has two chambers—a small one in front filled with Aqueous Humour, and a larger one filled with Vitreous Humour, and between them is the Crystalline Lens.

2. The eye is enclosed by the Sclerotic, which is transparent in front where it is called the Cornea.

3. The inside of the sclerotic is lined with black cells.

4. The Iris regulates the amount of light that enters at the Pupil.

5. The inverted image falls on the Retina, and the impression is conveyed to the brain by the Optic Nerve.

6. The eye is focussed by altering the convexity of the crystalline lens.

7. The eye is protected by (*a*) a bony orbit; (*b*) eyebrows; (*c*) eye lids and lashes; (*d*) a watery fluid.

Step V. Application.—The application of these few simple facts concerning the eye may do much to preserve or improve the eyesight of the children. Objects should not be held too close to the eye, as the effort required to produce the necessary convexity of the crystalline lens may strain the delicate muscles. Generally speaking, 10 or 12 inches is the best distance for the object, and any print or work that cannot be seen at that distance is too small for ordinary use. In reading or working the eye should be kept in the shadow, and the light allowed to fall on the object. If the sight is at all defective, an oculist should be consulted; spectacles should not be bought, like hats, by trying them on until a pair is found that seems to suit.

"Overstrain of the eyes causes headache, squinting, nervous irritability, great fatigue, and if the strain is prolonged the sight may be injured for life."

B. Taste and Smell.

Step I. Preparation.—Of the five senses, the organs of touch and taste tell the brain only of things with which they are in actual contact, but the others give knowledge of objects at a distance. In the case of the eye, rays of light come from the object, and are focussed by the crystalline lens on to the retina, but how can an object at a considerable distance affect the sense of smell? As a matter of fact the sense of smell is only affected by materials with which the nerves are in actual contact, for everything which possesses an odour gives off extremely minute particles which are carried by the air into the nostrils. How small the particles are that affect the sense of smell may be judged from the fact that a piece of musk will emit a powerful odour for years without sensibly decreasing in weight.

Step II. Presentation.—The sensation of smell is conveyed to the brain by means of the *olfactory nerve*, the fine ends of which are situated in the upper part of the nose. The nostrils, as cannot be too strongly insisted upon, form the proper passage through which to breathe, but the ends of the olfactory nerve are placed in a kind of chamber above the air passage, consequently, if we wish to detect a slight odour, it is necessary to give a sniff which draws the stationary air from this chamber and allows air laden with these fine particles to enter. These particles cannot affect the nerves until they have been dissolved by the moisture that is secreted by the membrane that lines the olfactory chamber; consequently if this moisture is absent, or if, through a cold in the head, it is too abundant, the sense of smell is temporarily affected.

The ends of the nerve which give rise to the sensation of taste are situated principally towards the back of the tongue and hinder part of the palate. The little projections or papillæ in which these nerve-endings are placed may be seen arranged in a V-shape towards the back of the tongue. When viewed under a microscope, many of the papillæ are seen to resemble leaf-buds in shape, and are therefore called *taste-buds*. Taste is in reality a complex sensation into which smell and even touch enter very largely, and anything which affects the sense of smell will also affect that of taste, so when it is necessary to take medicine which has a particularly unpleasant taste, the nostrils should be tightly pinched, by which means the taste is less decided or often completely removed.

Step III. Association.—The senses of taste and smell afford striking examples of how the sense-organs will improve or deteriorate, according to whether they are exercised or neglected. With most people, these senses merely tell in a very general and indefinite manner whether the sensation produced by a particular object is agreeable or otherwise, but that these senses are capable of imparting sensations of an exact nature and of discriminating between very fine shades of difference is shown by the professional tea-taster who has cultivated his sense of taste, and by many of the lower animals, in which the sense of smell is very highly developed.

Step IV. Formulation.—1. The sense of smell is caused by minute particles of some particular body being carried by the air into the nostrils, and affecting the olfactory nerve.

2. The sense of taste is strongest in the back of the tongue, and the hinder part of the palate.

3. These two senses are very closely connected.

Step V. Application.—These senses are exceedingly helpful to us in our endeavour to keep the body in a healthy state, but unfortunately they are neglected by many people. The very position of the nose immediately above the mouth suggests that it was put there to prevent the entrance of bad and improper food, which would be injurious to health. The presence of foul matter, that would poison the air and render the home unhealthy, can generally be detected by the sense of smell; but instead of taking advantage of the warning and removing the source of the evil, the unpleasant smell is often simply overpowered by another a little more endurable, while the source of the evil is allowed to remain and breed disease.

COMMON-SENSE NEEDLEWORK.

BY MISS FLEMING,

Authoress of "How to Teach Needlework," "Pupil-Teachers' Needlework," "Sewing-class Guides," etc.

MAKING BANDS.

PREPARATION.—Strips of calico (selvedge way), needles, cotton, and thimbles.

Conversation.—Elicit the difference between the selvedge and the weft of material. Elicit the parts of garments that require bands. Allow some girls to pull the calico to find the right way, and others to measure each other round the waist for bands, etc.

Information.—Bands should always be cut the selvedge way of the material, because it is stronger and does not "give" like the weft does. The length of the band is obtained by measuring the part for which it is required, and in addition making allowance for turnings and the necessary amount of over-wrapping.

The width depends upon the garment for which it is intended.

Drawers' tops are usually two inches deep when finished, while chemise bands are only one inch wide.

It should be remembered that all bands for growing children ought to be made long enough to wrap over well to allow for development.

It is more economical to cut garments in couples than singly. If the narrowest parts of the garments are placed end to end, double lengths of the material are produced along the selvedge, which give ample allowance for all bands. Sometimes they can be

taken from the under arm slopings of night-dresses and chemises.

Demonstration.—The proper length and width being secured, lay a narrow turn along the two long sides, on the wrong side of the material.

Turn the ends down.

Double the two long sides so as to meet at the edges, the folds being inside and facing each other.

Press it between the thumb and first finger of the right hand.

Seam the ends neatly.

Gathering and Stroking.

Preparation. — A.L. Sewing Illustrator, a skirt gathered into a band, a large sheet of calico coarsely gathered but not drawn up, marked with red at the "half" and "quarter," a band of proportionate size, and a knitting needle.

Strips of calico taken from the width of the material, needles, coloured and white cotton, rug needles, pins, and bands made during previous lesson.

Conversation.—Let the class look at the skirt, and elicit that the middle is attached to the middle of the band, that the length of the skirt is selvedge way, that the fulness is equally distributed, and that the width of the skirt is double that of the band.

The lesson naturally divides itself into four parts:—

1. Gathering.
2. Stroking.
3. Making bands.
4. Setting in the gathers.

1. *Gathering* is a method of preparing that part of a garment which requires to be inserted or fastened on to another of shorter measurement. It is used where freedom of movement is needed, and it is adopted when setting chemises, skirts, petticoats, etc., into bands and yokes.

Demonstration.—Show how to "half" and "quarter" the strips of calico by making a cross with coloured cotton.

Show how to make a crease, half inch from the edge, as a guide for the running stitches. Some people draw a thread for that purpose, but it weakens the fabric.

Show, on the Illustrator, how the gathering stitch is made.

If the material be rather coarse, two threads are taken on the needle and four left between the stitches. For muslin or fine fabrics more threads may be taken up, but, in any case, the amount left between the stitches is just double that on the needle.

Two or three running stitches can be taken on the needle at one time, if the material be soft enough to allow it.

Pass round the class quickly to see that this part of the exercise is properly done.

Show how to draw the gathering up by beginning near the loose end and working gradually toward the other.

Draw the thread up as tightly as possible and fasten it firmly round a pin on the left.

2. *Stroking.*—By means of the knitting needle, show how the rug needle is to be held during stroking. The blunt point of the latter will not fray the calico as pins used by unskilled fingers are likely to do.

Take each gather and push it between the thumb and forefinger of the left hand, so as not to "scratch" the work. If the gathers above the running are also arranged neatly, it will help those below to fall more easily into place. Probably the thread will require drawing up more tightly after a little stroking has been done.

Whilst the girls are stroking, the teacher should closely scrutinise their movements and bring out the slower ones for extra teaching.

Probably this will be enough for one lesson, but it may be continued or broken off at discretion.

3. *Making Bands.*—See previous lesson.

4. *Setting in the Gathers.*—Show how to mark the band to correspond with the exercise already stroked.

Comment upon the proportion of band to fulness (the latter is double the length of the former), which way of material both are cut, and why both are marked in the same places.

Take out the pin which fastens the gathers.

Make the thread the same length as the band.

Arrange the gathers evenly.

Fasten gathers and band together by pins placed in the middle and at each end, keeping the marks opposite each other. The gathering stitches should come just under the edge of the band.

Tack the band firmly into place. It requires care to do this without disarranging the gathers.

Push the needle straight through from front to back, and then from back to front.

Set the class to do the same and examine the work.

Commence sewing on the band.

There are various ways of holding the work in this exercise, but I prefer it to be placed across the end of the first finger as in hemming. The needle is put through only one gather at a time.

The band must not be puckered.

Each stitch should fall into a groove of the gathers.

The stitches will be upright on the right side, if the gathers are close together.

Where the gathers are few, the stitch will be slightly slanting.

While the bands are being sewn on, notice carefully the method of working, and make corrections if necessary.

The under side may now be done.

It must be tacked down (even when proficient, the girls must not omit the tacking) so that the setting in stitches at the back will fall directly behind those in front. If they are placed either higher or lower, the band will be drawn awry and the work will be unsightly.

Fixing and Running Tucks.

Preparation.—A hem and two tucks fixed on white paper having coloured chalk or pencil lines drawn 1½ inches apart to represent the lined paper used by the class. A corresponding sheet of paper (lined like the other) unfixed.

Squares of lined cutting-out paper 6 inches square, for each girl, needles and cotton.

Conversation.—Show any tucked garments and elicit the purposes served by the tucks. Elicit all information that can be gained from looking at the articles, and the prepared specimen, such as, where the tucks are placed, how arranged, width of tuck and distance apart, etc.

Information and Suggestions.—Tucks are folds of cloth kept firmly in place by a line of running. They are used on garments that may require lengthening

for growing children, for hiding a join, but more commonly for ornamentation purposes.

They are laid horizontally at the bottom of such garments as petticoats, babies' robes, aprons, and drawers, but perpendicularly in front of a night-dress or chemise. They are usually placed in groups of odd numbers as 3, 5, 7. The spaces between the tucks should be uniform.

The width of tucks varies according to the garment to be ornamented—for instance, babies' clothing, underwear, blouses, etc., require very tiny tucks, whereas wide tucks are better for aprons, skirts, etc. Small garments should have small tucks. Sometimes all are the same size; at others, they get gradually narrower; while in many cases they are placed in groups separated by a space or a broad tuck. For narrow tucks the space and tuck are of equal width. They "set" better when made to run with the selvedge.

The fixing is done by careful measurement and folding.

We will suppose that a broad hem and two tucks are to be fixed.

Demonstration.—Make a fold half a space deep on the large sheet of paper.

Double the fold over again, along the third line from the edge, to form a broad hem.

Tack this firmly.

Turn the work round and draw a coloured line to represent the hem on the right side.

Show, by folding the paper, how each tuck, being a double fold, covers a space equal to its depth, and takes up three spaces. Show also that the distance between two tucks equals the depth of the tuck.

Make a crease along the third line from the hemming stitches, to form the edge of the first tuck.

Double this over and crease it, along the next line above, so as to make the edge of the tuck fall parallel with the *first* line over the hemming stitches.

Tack this along the inner crease, under the tuck.

Point out that the running stitches come close below the tacking thread. The running itself, however, will not be done until next lesson.

The girls will be able to see for themselves that the running of the first tuck falls along the fourth line from the hemming stitches.

The top of each succeeding tuck will be four spaces from the running of the one below it.

Calico should be used for the second lesson, along with measuring tapes or rulers. The teacher's paper or calico specimen should be plain, that she may teach how to measure.

It must be remembered that a tuck always occupies three times its width, the upper surface of the tuck, the lower or under side, and the width of material that it lies upon, while, in addition, calculation must be made for a clear space of fabric between the tucks, as they show to better advantage when placed a little distance from each other.

This time the hem might be one inch deep, the tucks half an inch, and the space between the tucks also half an inch. That will make the running of the first tuck come two inches above the hemming line.

It will be easily seen that this space is divided into four parts.

The lowest half inch forms the distance between the hem and the tuck.

The second one is the space on which the tuck rests.

The third one forms the under part of the tuck.

The fourth is the upper part of the tuck.

When a long tuck is to be run, it is a good plan to make a measure, by means of which the width can be kept uniform all the way.

The depth must be tested constantly while the running is in progress.

A measure can be made something like Fig. 1.

Place point C on the hemming stitches.

Point A indicates the folded edge of the first tuck.

Point B marks the position of the line of running stitches.

Some people draw a thread to keep the running straight, but that weakens the fabric, and is not necessary if the measuring be exact, and the tuck be

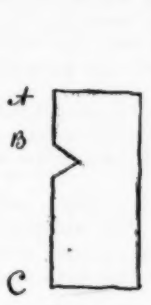


FIG. 1.

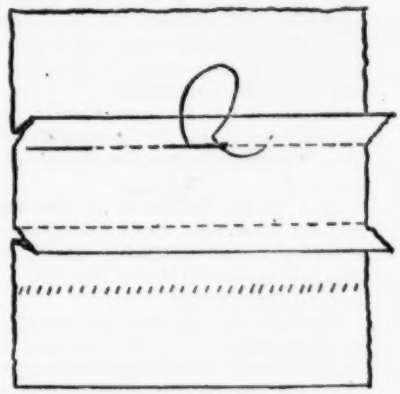


FIG. 2.

doubled down to form a crease. The running is done on the under side of the tuck, along the inner crease.

The stitches are quite regular and horizontal. A general rule is to take two threads and leave two, but as much material is taken on the needle as is left between the stitches.

When using fine, soft material, two or three stitches may be taken on the needle at one time. (See Fig. 2.)

When arranging wide tucks, estimate for the space being half the width of the tuck itself: *e.g.* for inch-wide tucks calculate half an inch space between them.

Tucks for dressmaking purposes do not follow any rule, as, being solely for ornament, they are placed as fancy dictates.

THE CARE OF HOUSEHOLD LINEN.

Some Uses to which Worn Articles may be Put.

A thrifty housewife has many opportunities of increasing domestic prosperity by prudent management, and the judgment she exercises in the making and repairing of clothing.

Thrift is an old Saxon word denoting good husbandry, and is applied to the careful conducting of all household affairs. Especially is it applicable to the consideration of house linen, which may be made to last much longer if carefully repaired as soon as the first signs of wear and tear appear.

The term household linen is not, as formerly, confined to articles made of linen, for now it includes, besides table napery, sheets and pillow-cases, blankets, and all such articles of domestic use, whether made of calico, linen, print, or woollen goods.

The repairing and keeping in order of house linen and raiment involves a good deal of time and labour, but a true housewife does not mind that. Indeed she takes a good deal of pleasure in the doing of it thoroughly.

A good needlewoman will, most probably, be a good and economical housekeeper, for the care which doubles the life of an article by the "stitch in time," will most probably be bestowed on all connected with home.

It is not possible to lay down rules for repairing all articles of personal and household use. General directions are given, but much must be left to the mender's common sense and judgment.

In olden times, when our grandmothers wove their own linen, which wore a lifetime, infinite attention was bestowed upon both the mending and making of garments, and mothers took great pride in seeing that their daughters possessed linen chests well lined with hand-fashioned garments before they left the parental roof for their own homes.

Indeed, it was no uncommon thing for a girl to commence preparation for her future home, in the shape of a "bottom drawer," as soon as she was able to sew well.

Such things, fashioned of the best materials, containing often the most painstaking and elaborate stitchery, were naturally prized, and patching and darning became almost a fine art. It has, alas! now greatly deteriorated.

It is to be hoped, however, that as education becomes more practical, wives and mothers may become better needlewomen. A few general suggestions on the subject may not be considered out of place. They may serve as a guide to the teacher who, lacking in experience, yet wishes to teach mending to her class.

A good housekeeper will set apart weekly, or bi-weekly, a time for repairing personal and household plenishings. The older girls who have learnt patching and darning at school should be encouraged to take upon themselves a share of such home duties.

They will gladly do this if they have been taught on the lines recommended. As a matter of fact all these lessons have been discussed with, and practised by, girls from eleven to thirteen years of age in an elementary school.

Young people take a particular delight in hearing their teacher talk about the things she uses in her own home, and when she holds up for their inspection a tablecloth that has done duty on her own table, and which is beginning to show signs of wear, they become greatly interested, and enter with much verve into the methods to be adopted to prolong its life.

A drawer or bag should be set aside in which neat rolls of muslin, old linen, flannel, etc., are stored that they may be at hand when needed. Fine soft old linen is very valuable for bandages, wounds, etc. Coarser dirty pieces should be washed and scraped for lint.

Coarser flax materials will come in for mending and making towels, dish-cloths, etc.

Some excellent towels have been made out of the best part of an old linen bed-tick, which was cut up into suitable sizes, well boiled, and hemmed for the purpose. They lasted much longer than ordinary material bought by the yard.

Muslin curtains are, as a rule, mended when "rough dry," but sometimes it is advisable to repair them, or at least to draw the holes together, before they are washed, otherwise they may get past it. The best parts of long curtains can be cut up for short ones, and the pieces too small for that purpose come in nicely for poultices and strainers.

Worn calico garments may be torn up and joined together for dust sheets and dusters, and the bottom part of one old chemise will occasionally come in for the top part for another.

The mending of sheets and blankets will be treated in a separate chapter.

Women's woollen combinations, after being darned as long as possible, may be turned into small ones for children.

Another economical method is to make them into long-sleeved bodices, for wearing under a cotton blouse. The body part is left as it is, for, as a rule, that is fairly good, when parts of the legs are worn out, or mended as much as is advisable. The legs will, no doubt, contain enough good material for the long sleeve.

If, as is sometimes the case, the fronts have "run up," until too tight to wear over corsets, a shaped piece of flannel sewn on to the left or button side will provide increased width. The fit may not be perfect, but a warm comfortable garment will thus be added to the wardrobe.

Towels have an awkward habit of developing holes because of being hung up without a loop for the purpose. They get dirty, too, with slipping to the floor for the lack of the same precaution.

Holes are made by pinning garments which ought to have button or string sewn on. When a button is loose a few stitches would prevent it coming off.

Rents and cuts in articles too dirty to be properly mended should have their edges loosely run together before washing, as the washing and wringing often accentuate holes.

When a tablecloth is too far gone to be darned, it may be cut up into serviettes, fish-napkins, tray-cloths, small cloths for pie-dishes, d'oyleys, etc.

Patching in Print.

As a rule, a print patch is needed for neatness, rather than strength, and it is important that the pattern should be carefully matched, so as to make it look as much like the original as possible. Stripes and squares are suitable for beginners, to be followed by spots or more difficult patterns.

A little management is needed to make the flowers and figures, etc., fit in, but girls like to exercise their ingenuity in making the pattern look well. Except for the neat square indicated by the regular seam stitches, no patch should be discerned.

The custom in all mending is to make the new part extend a good way beyond the old, so that the thin place round the hole may be covered. For this reason, the patch should be at least an inch larger every way than the hole it is intended to hide. It may be either square or oblong.

The patch must be the same way of the material as the garment on which it is fixed.

It must be cut very evenly.

A single fold is laid on the wrong side, about one-third of an inch deep. (See Fig. 3.)

The corners must be quite square.

The patch is tacked firmly over the hole. (See Fig. 4.) It is seamed on the right side with cotton

that will make the stitches as little visible as possible. (See Fig. 5.) Strict supervision should be exercised over the commencing, joining, and fastening of the cotton. These were dealt with in the chapter on "Seaming."

After the tacking threads have been taken out and the seam stroked quite flat, the exercise is turned round to the wrong side.

It should be stroked again, especially at the corners.

When fastening off, put the needle through the loop of the first stitch, that there may be no break in the continuity of the line.

Overcasting is sometimes termed "blanket stitch" or embroidery buttonhole stitch.

It differs from the actual buttonhole in not having the same twist.

It is a kind of top-sewing, and is used for preventing the raw edges of blankets fraying, and for making neat

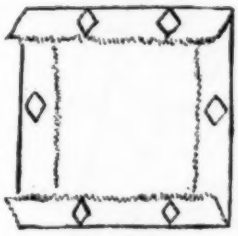


FIG. 3.

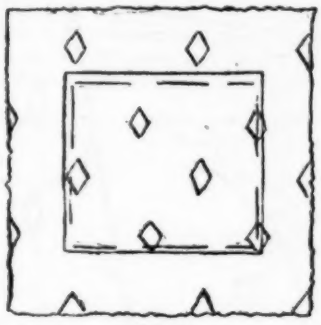


FIG. 4.

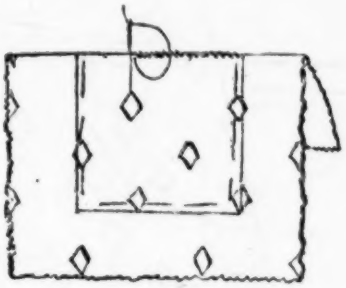


FIG. 5.

Diagonals are cut from the hole to within one-third of an inch from each corner. (See Fig. 6.)

The flaps, which come between the diagonals, are turned back and cut straight.

The edges are overcast to keep them from fraying. (See Fig. 7.)

Overcasting.—Commence by running a few stitches on the edge under the patch to make the cotton secure.

Put the needle through in a straight line from the left-hand top corner.

Bring it out half way between the edge and the seaming stitches.

N.B.—The overcasting stitches should be half the depth of the edge to be neatened.

Hold the cotton with the left thumb.

The distance between the stitches is rather less than the height of each stitch.

Sometimes the edges are opened out and both sides overcast. (See Fig. 7.) More often they are closed, and the double material made neat in the manner already described. (See Fig. 8.)

Join the cotton as in the beginning, but take care to put the needle through the last loop stitch.

such seams as are on the wrong sides of patches or dress materials.

MENDING AN APRON.

The art of patching is a very valuable one. It is not only economical, by making the article wearable for a much longer time, but it is also indicative of the thrifty character of the housewife.

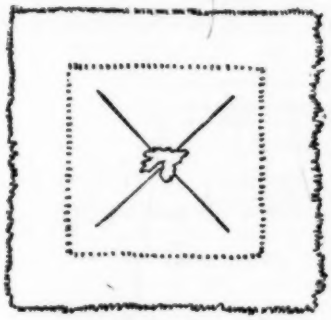


FIG. 6.

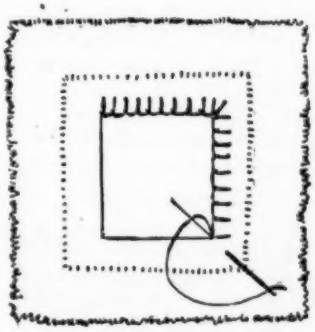


FIG. 7.

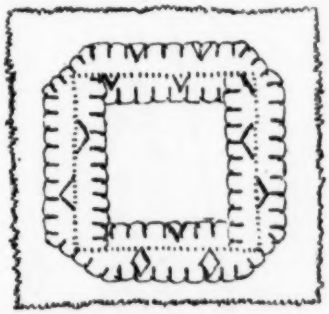


FIG. 8.

A woman who keeps her own and children's clothes in thorough repair will prove a careful manager in other respects. She will be a home-lover, and no gossip, for the making of old garments into new ones takes up much time, and requires careful planning and arranging.

Materials for mending should be as like the original as possible, as the aim is to replace the original texture as far as that can be done. A print patch matched carefully, and sewn very neatly, will not offend the eye.

Most outer garments of washing material such as aprons, pinafores, children's dresses, overalls, and print blouses, usually require the "Print Patch" treatment. Aprons wear into holes just below the

band, and very many with large ones will be brought to school by girls to be repaired.

The difficulty in the case of the apron lies in the gathers.

The band must be unpicked a little distance beyond the hole on each side. (Fig. 10A.)

FIG. 9.—Holes to be mended.

Draw lines with coloured chalk about an inch beyond the hole on three sides, so as to enclose the thin part that surrounds it.

The edge of the patch in Fig. 10A represents those lines.

They also indicate the size of the completed patch.

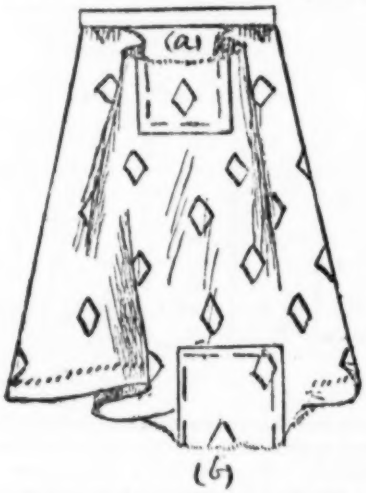


FIG. 10.—Showing band and bottom unpicked and patches tacked on ready for seaming.

Cut the mending fabric large enough to allow the pattern to fit properly, leaving enough for turnings. The pattern itself indicates the right way of the material. It would not fit otherwise.

Turn it down on three sides only, leaving the top unfixed.

Pin it carefully into place, the gathers being straightened out for the purpose.

Tack the three sides firmly.

Seam these neatly. (Fig. 11A.)

Take out the tacking threads and *stroke* thoroughly.

Overcast the under edges.

Gather the top.

Set the band on. (Fig. 12A.)

FIG. 11.—Showing both patches seamed on the right side.

A Hole in the Bottom of an Apron.—Undo the hem for some distance at each side of the hole.

Lay it out flat.

Chalk out three sides of a square. This is indicated by the edge of the patch. (Fig. 10B.)

Cut the patch large enough for the pattern to fit and to form turnings.

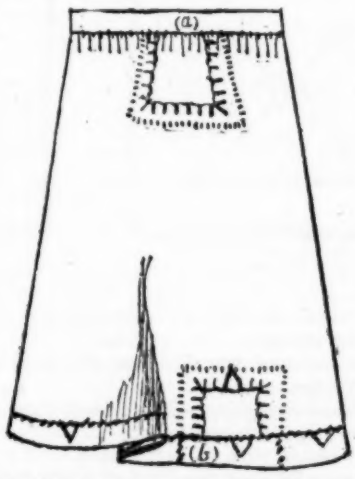


FIG. 12.—Showing apron completed on the wrong side.

See that sufficient is left to form the hem at the bottom.

Fix and tack the patch on. (Fig. 10B.)

Seam it neatly. (Fig. 11B.)

Overcast the under side and complete the hemming. (Fig. 12B.)

THE GEOGRAPHY OF PALESTINE.

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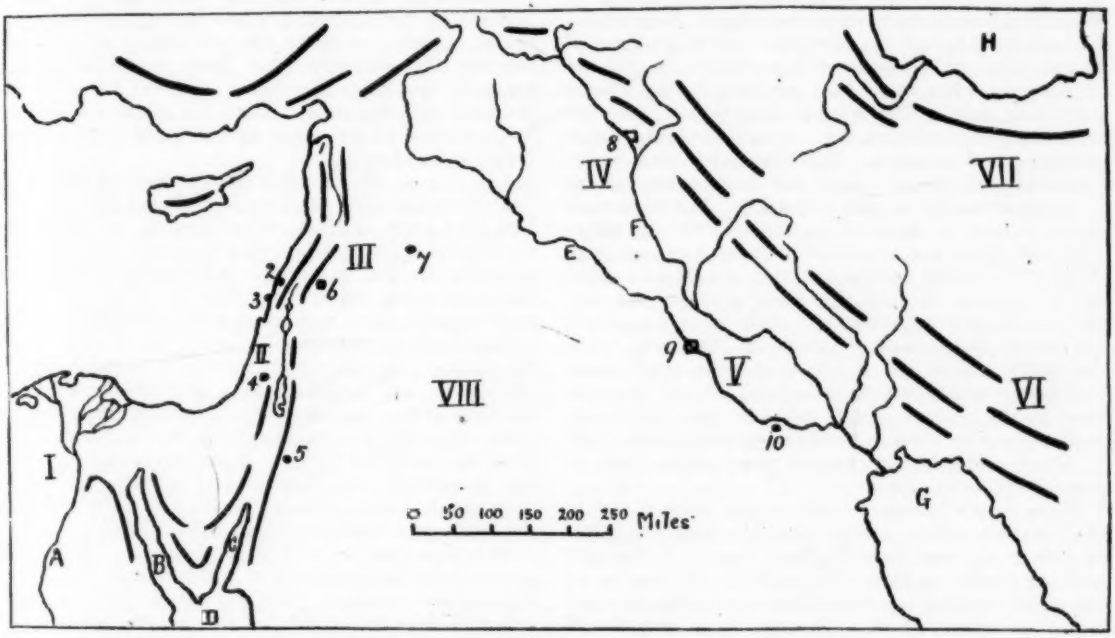
(*Continued from p.* 135.)

THE vegetation of Palestine can now be considered after the study of the relief of the land and the climate. Because there are such great contrasts in the relief and such very different climatic conditions, there are great contrasts between the kinds of vegetation in the different parts of the land. Moreover, because the rain, upon which growth depends, comes only in the winter time, and the summer is hot and dry, the country presents a very different appearance in these two seasons. The general impression received by a visitor from England would be that of infertility; the land would strike him as being poor and generally inhospitable. Only in spring and early summer would he regard it as being "a land flowing with milk and honey." Even then he would consider this a somewhat exaggerated estimate, unless he happened to be in one of the few exceedingly fertile districts, or unless he had come, as the Israelites had come when the phrase was used, from the desert of the south-east, in contrast to which Palestine is certainly a favoured land.

We may distinguish *five types of country* from the point of view of the vegetation. First there is the tropical region of the Great Depression — a region of exuberant fertility, where the soil is on the whole soft and well adapted to plant growth. The heat is great, and water is obtained from the Jordan, or the streams which come down from the highlands on either side or issue from springs in the mountain slopes. There is sufficient water to allow irrigation throughout the district, and the cultivation might be extended very much beyond what at present exists. A great drawback, however, is the malaria which is prevalent, and this in part accounts for the paucity of inhabitants.

The second type of country consists of the fertile lowlands, on which are grown chiefly grain and fruit. The chief grain crops are wheat and barley. The former has been the more important; wheaten bread has always been preferred, barley being used only when wheat could not be procured. The farmers plough the ground when the "early rains" come, at the end of October or the beginning of November. If these rains are late, the ground is too hard and dry to be cultivated, and so the work is delayed and the final harvest is imperilled; hence great importance is attached to the due arrival of the "early rains," which are frequently mentioned in the literature. The temperature is generally sufficient to allow growth during most of the winter, and the early spring sees a rapid increase in the plants, for all the winter through there is rain. In late spring the heat becomes great, and the plants would be dried up were it not for the last rains of the season, which fall at the beginning of April, and are called the "latter rains." These, therefore, are regarded as very important, and also find frequent mention.

The great festivals of the Passover, Pentecost, and



SKETCH MAP SHOWING THE LANDS ADJACENT TO PALESTINE.

Regions.—I. Egypt. II. Palestine. III. Syria. IV. Assyria. V. Babylonia. VI. Persia. VII. Media. VIII. Syrian Desert.

Towns.—1. Antioch. 2. Sidon. 3. Tyre. 4. Jerusalem. 5. Petra. 6. Damascus. 7. Palmyra. 8. Nineveh. 9. Babylon. 10. Ur.

Rivers and Seas.—A. Nile. B. Gulf of Suez. C. Gulf of Akabah. D. Red Sea. E. Euphrates. F. Tigris. G. Persian Gulf. H. Caspian Sea.

Tabernacles were not only of historical significance, but marked the stages of harvesting. They were times of thanksgiving, not only for incidents of the history, but also for the success of the agriculture—a success which was by no means certain, and yet the lack of which meant famine and suffering. The Passover Feast and the Feast of Unleavened Bread which immediately followed heralded the beginning of harvest in the middle of April. Seven weeks later was the Feast of Pentecost, which was a Harvest Thanksgiving: "Ye shall bring out of your habitation two loaves . . . of fine flour; they are the first-fruits unto the Lord." This would take place early in June, and then came a spell of hot weather, during which the olive and the vine yielded their fruit, and so at the end of the summer, when the oil and the wine had been safely obtained, the Hebrews held their Feast of Tabernacles: "The feast of ingathering, in the end of the year, when thou hast gathered in thy labours out of the field." The fruit, besides that of the olive tree, comprises apricots, figs, almonds, walnuts, pomegranates, and oranges. The date-palm used to be grown extensively, and might still be cultivated as far as physical conditions are concerned. The vines were grown largely in terraces on the hillsides, wherever sufficient rain was obtained. These terraces were designed to bank up the soil into a sufficient depth and to prevent it gradually washing down, but they are now largely neglected, and their ruins accentuate the stony appearance of much of the land. Undoubtedly cultivation of all kinds was much more thoroughly and extensively carried on in the past than in the present, and it would be possible for the production once more to be increased very greatly, and to afford sustenance for many more people than at present live in this land.

These fertile lowlands have, as was pointed out in the previous article, a soft and fairly rich soil; they receive more heat than England does, and they are watered partly by their own rainfall, and partly by the water draining into them from the better watered highlands above them. Among them one should mention the maritime plains of Philistia and Sharon—the phrase "Rose of Sharon and Lily of the Valley" is suggestive—the plain of Esdraelon, and the plateau of Bashan. The plateau of Bashan stretches farther to the east than the other fertile regions beyond the Jordan, and so here the people were able to settle at a greater distance from the Mediterranean Sea. This explains why the maps of Palestine bulge out, as it were, into the desert at this spot; in the maps showing the tribal divisions this was the portion of the half-tribe of Manasseh, and in Roman times the Tetrarchy of Philip is similarly thrust out to the east. Besides these larger fertile areas, there are smaller valleys cut into the mountains, such as those in which Samaria and Shechem stood.

The third type of country is the forest land. This is not covered by a very dense forest; the trees do not usually grow to great heights, nor is there much undergrowth. As one would expect, the forest grows on the mountain slopes where there is a considerable rainfall. The mountain range of Carmel, with that portion of the plain of Sharon underneath it, is such a forest region. The northern portion of the Central Range, especially in Upper Galilee, bears forest, and the cedars of Lebanon are famous. In the Eastern Range, Gilead and Anti-Lebanon are well wooded, and the mountains east of the plateau of Bashan also have trees.

Rough and poor pasture land comprises the fourth and most extensive type of country. It is the limestone region, which receives comparatively little rain, and the poorness of the land is most noticeable in the southern parts of Judæa and the slopes of the mountains which face away from the sea. After the winter rains this land becomes thick with grasses and frequently bright with flowers, but all this withers during the summer, and is entirely gone in the winter. Where water is obtained from springs which flow after the rains have ceased fertile oases occur, and may give rise to permanent settlements.

The desert is the last type of country. A few portions even of Palestine might be regarded as being almost desert, for there are not sharp distinctions between the different types just enumerated, but, generally speaking, the desert enclosed Palestine on the east and the south. Here the vegetation, where it exists, is of a very scanty nature, except again in the better watered oases.

The animals of Palestine should receive attention next, for where they can live depends largely upon the food they need, and this either directly or indirectly depends on the vegetation. In a country which on the whole is dry and has rather poor pasture sheep can live, and goats under even harder conditions; but cattle require more water and richer pasture. Sheep and goats therefore form the chief animal wealth of the people; they are kept for their products, which afford meat and drink, clothing and shelter even, for the tents of the nomadic tribes are chiefly of goat-skin. Oxen were used as draught animals and in agricultural work in the settled regions. Camels assisted travelling, and horses were employed mainly in warfare. These were the domestic animals; the wild animals included the lion, now extinct, the bear, and the wolf.

Such were the resources of the country. It remains to consider *the occupations* in which the people found it possible to engage. The account of the geological structure showed that most of the country is composed of limestone, a smaller area of more recent soft deposits, and a still smaller area of volcanic rocks. Therefore the important and valuable minerals are lacking, for these are found in older rocks, which do not occur at all in this country, unless possibly at great depths. Hence mining is impossible, and as modern methods of manufacturing depend largely upon mineral possessions, one cannot imagine manufacturing as an important industry. The chief occupations must always be, as they have been in the past, agricultural and pastoral. Sufficient has already been said to indicate the agricultural possibilities; one needs only to emphasise the fact that pastoral occupations—the feeding of sheep and goats particularly—are naturally the staple business of the people. One is not surprised, therefore, to find the frequent references to sheep and shepherds in the literature, from the similes of the earliest psalms to the parables of Jesus.

Trading is the only other means of livelihood, and to consider the possibilities of trade, except of a purely domestic and internal character, we must look at *the position of Palestine* in relation to other countries. This is shown by the accompanying sketch map. It will be seen that this land lies at the meeting-place of the three continents—Europe, Asia, and Africa—and this situation accounts for much of its history.

Before the rise of the Greek and Roman empires of Europe it lay between the ancient empires based upon the Nile in Africa, and upon the Euphrates and Tigris in Asia. Both these regions are in the great desert area, and derive their water, and therefore their life, from the rivers which come from far-distant mountainous and rainy districts: the Nile brings the water from Central Africa, while the Euphrates and Tigris derive their supplies from Asia Minor and north-western Persia. The great desert area, therefore, is cut across by these important river basins, which have given rise to ancient civilisations and formed easy routes for communication. The great trade routes of the world until quite recent times were those from the East to Europe, and these in the main followed two roads. The first was by way of the Persian Gulf and Mesopotamia, and it then divided into three branches; one went across Asia Minor to the Black Sea and thence by ship, a second from high up on the Euphrates across to Antioch, a third from a lower point on the Euphrates across the desert to the oasis of Palmyra, thence to Damascus, whence the traffic passed to the Phœnician trading cities of Tyre and Sidon. The second great route was by way of the Red Sea across the narrowest part of the desert between the Red Sea and the Nile, and down the Nile to the Mediterranean Sea.

Palestine, therefore, lay between these two great routes and out of the direct current of trade between the East and the West of the ancient world. The only trade it could share was that between Mesopotamia and Egypt. The traffic crossed the Syrian desert from Mesopotamia by means of the two oases, Palmyra and Damascus. Here the route branched. As mentioned in the previous article, one road was that through Bashan to Esdraelon, by Megiddo or Dothan, to the maritime plains of Sharon and Philistia, and then, still skirting the Mediterranean, to Northern Egypt. The other road proceeded from Damascus directly southwards, avoiding on the one hand the desert, and on the other hand the uneven and broken land of Palestine; it kept on this road, which gave just sufficient sustenance and also a fairly level journey as far as Petra, and then turned westward across the wilderness of Paran north of the Gulf of Suez to Egypt.

It appears, then, that Palestine itself was directly concerned only with a part of this cross trade between the great river civilisations, and that the mountains of Judæa, the heart of Palestine, lay between the two chief roads of this commerce. Hence their isolation, and one reason why the Jews of this portion could maintain their independence after their kinsmen in other parts had succumbed to invaders. As a matter of fact, only at one period of the history of the Hebrews, when Dāvid and Solomon ruled over all the land from Damascus to the Gulf of Akabah, could the people reap much advantage from trade, and hence this occupation was always comparatively unimportant.

Considering the resources of the land, one would not expect a large and dense *population*. At the present time it is estimated at about 600,000 persons, that is, less than Liverpool. That gives an average density of about 50 people to the square mile; the British Isles have, taking them as a whole, about 350 people to the square mile; Jerusalem has about 60,000 people, and is therefore about the size of Wigan or Hastings; the more northern trading cities are larger, Beyrout having about 120,000, and Damascus 180,000 inhabitants. But this present population is certainly much less than that of the past. As before stated, cultivation was far greater, and the country supported a population which has been estimated at various figures from 2,500,000 to 5,000,000.

The manner in which the geographical conditions of the country affected *the history of the people* may perhaps best be indicated by reviewing briefly the course of the history during the period covered by the narratives of the Old Testament. These narratives must, for our present purpose, be regarded as ancient historical documents; and the research of recent years has enabled us to analyse them, to estimate their historical value, and to supplement them by material gathered from the records of the neighbouring lands. As a result of such work, we are justified in regarding the accounts of the earlier periods of Hebrew history—the period from the time of Abraham to the Exodus—as giving the history in a somewhat parabolic form. The actions of the nation or the different tribes are attributed to particular persons, such as the traditional ancestors of the tribes in question; *e.g.* when the narrative speaks of Joseph wishing to be above his brethren, we probably have a reference to this tribe endeavouring to obtain the supremacy over the other tribes. This was the common method of setting forth a traditional history, especially when the chief aim was to teach a moral lesson.

Thus when we read of Abraham wandering from Ur of the Chaldees to Upper Mesopotamia, thence to Haran, Damascus, and Canaan, we are shown the probable route by which the nomadic ancestors of the Hebrew race wandered from place to place, seeking suitable land for the flocks and herds, and finally settled in Canaan. It is to be noted that the meaning of the word "Canaan" was "Sunken," and was applied at first to the lowlands inhabited by the real Canaanites, but was afterwards extended to the whole land. The term "Hebrews" meant "Dwellers across the river," but it is doubtful whether the river to which the crossing referred was the Jordan or the Euphrates, for the Hebrews had crossed both. Then we read of Abraham, *i.e.* the nomadic peoples, wandering onward to Egypt when the rains failed in Canaan, returning again to the country more suited to their occupations and habits when the droughts had passed. The quarrel which resulted in the separation of Abraham and Lot was typical of the way in which an increase of animals and people led to the emigration of some of them, for the lack of water and pasturage has been responsible for many waves of emigration from the semi-arid portions of Asia. In this case Lot chose the fertile plains of the Great Depression, while Abraham remained on the hills of Judæa. Space will not permit one to go into the subsequent misfortunes of Lot; one can only suggest that the destruction of the cities of the plain certainly had some historical basis, and was probably due to the accidental ignition of large quantities of inflammable gas and petroleum from the bituminous matter which exists in great deposits in the rocks of this region. There is no evidence, one might add, of any volcanic outbreak in historical times.

The final movement of Lot across to the Eastern Range, and the birth of his sons Moab and Ammon, bear reference to the fact that the peoples of Moab and Ammon were akin to the Hebrews; similarly, the story of Ishmael points to the relationship of the Hebrews to

the wandering tribes of the peninsula of Sinai. The history of Jacob and Esau also refers to tribal movements. The settlement of Esau in the land south-east of the Dead Sea suggests the origin of the people of Edom. The journey of Jacob after his quarrel with Esau to Haran, and his return with his twelve sons, probably refers to a second immigration into Canaan on the part of the same race when the twelve tribes had become more numerous and clearly differentiated one from another. From this time forth the mutual jealousies and quarrels of the tribes play an important part in the history of the Hebrew race.

The sojourn in Egypt was again brought about by lack of rain, and after some hundreds of years the Israelites had greatly increased in numbers, but had been degraded to a servile condition. The route of the Exodus and the wanderings cannot be accurately determined, but the important fact is that the people lived their old nomadic life in or near the desert for more than a generation. Their environment in Egypt tended to demoralise them, but the wandering life which followed weeded out the weak and accustomed the survivors to bear hardship and face dangers until they were able to attempt the conquest of the Promised Land.

This conquest of Canaan was commenced by the descent from the mountains of Ammon into the Great Depression, the crossing of the Jordan at the fords near Jericho, the capture of Jericho, and the advance up a deep valley behind the city leading into the heart of the hill-country. The invaders were successful, but their conquest was incomplete. They did not take all the cities, nor did they exterminate the inhabitants. On the contrary, they lived side by side with them, and learnt the rudiments of several arts from them, including that of agriculture. The Canaanites associated idolatry with their agriculture, and in this way the Israelites tended to lose the purity of their religion. These changes took place in the time of the Judges, whose work was twofold. First it was necessary to keep the purity of the religion and the unity of the tribes, for when the Israelites came into this land of contrasts a tribe settled in one region would have a set of circumstances, work, interests, and neighbours entirely different from those of a tribe in another region. Hence it was only occasionally that the tribes would unite, and that was when they were persuaded by their leader to fight their enemies both within their borders and on their boundaries. Thus it was the second duty of the Judges to organise warfare, and such men as Barak, Gideon, Jephtha, and Samson became their heroes. The accounts of these campaigns are well worth studying, for they illustrate how the sites of battles are determined by the geography; the plain of Esdraelon and the fords of Jordan figure again and again. Barak, for example, had to fight Sisera on the banks of the river Kishon, for Sisera had come into Esdraelon that he might separate the tribes of the north from those of the south. Similarly, the battle of Aphek, the news of which was fatal to Eli, was fought to prevent the Philistines entering this vital piece of territory. The choice of Saul as King was an attempt to secure unity, and the difficulty of this was shown by the repeated opposition which David had to encounter before the succession was assured to him. The reigns of David and Solomon marked the high-water of Hebrew power; the Kingdom was divided when Solomon's son ascended the throne, and the history of the next four hundred years is occupied with the struggles of the Two Kingdoms against the empires which grew up around them. First the Syrian rule grew up around Damascus, and this naturally affected the Northern Kingdom most. On the other side of Syria arose the Assyrian Empire based upon Nineveh; this overcame Syria and eventually took Samaria, the capital of the Northern Kingdom, and sent the people into exile beyond the Euphrates. The Assyrian Empire then decayed, and the Babylonian Empire flourished and extended its rule until Jerusalem itself was captured, nearly 150 years after the fall of Samaria, and the Jews suffered exile. Previous to this calamity, and indeed from the division of the Kingdom, the politics of the Jews were concerned with their relations to the different peoples around them. The work of Isaiah, for instance, was partly religious and partly political, and his writings cannot be understood without a knowledge of the relation of the Jews to their neighbours. The Babylonian Empire followed the way of the others; the city was taken by Cyrus of Persia, who founded a rule which extended from the Caspian Sea to Egypt. Under this rule the Jews were restored to their own land, and Jerusalem was re-fortified. Yet in a little more than a hundred years after Nehemiah had rebuilt the defences Alexander the Great came to Syria, and the Greek dominion was established. Then the Maccabean rising obtained Jewish independence for a time, but the growing Roman Empire established its rule shortly before the time of Jesus. This rapid summary of the history must close with the mention of the destruction of Jerusalem and the end of this part of the history of the people. Enough has been said to show how the geographical conditions of the land itself and the surrounding regions have affected the history, and to suggest the lines on which a further study of the historical geography may be pursued.

NOTES ON AN EXPERIMENTAL COURSE OF LESSONS ON PLANT LIFE AND SOIL.

BY EDWARD J. RUSSELL, D.SC. (LOND.),

Lecturer in Chemistry, South-Eastern Agricultural College, Wye.

(*Continued from p.* 129.)

THE children had now a fairly good idea of the action of running water on soil, and we proceeded to apply the knowledge gained from the preceding experiments to see if we could ascertain why the villages on the local river had been built in the particular positions they occupied. We confined our attention to a stretch three miles up and three miles down stream.

It was known that the bed of the river at the Wye Bridge was formed of pebbles, and that both up and down from the bridge the bottom was mud. It followed that at Wye Bridge the velocity of the stream was more rapid than above or below. A similar relationship was known to hold in the next village. The children easily arrived at the conclusion that the higher velocity at Wye Bridge was caused by the stream being either narrower or more shallow than either up or down.

We next examined the soil by the method of

Experiment 72. Discs of perforated zinc, about one inch in diameter, were placed in each of three funnels and covered with filter paper. Into the first was put a little soil taken some distance above the bridge, into the second a sample taken at the bridge, and into the third a sample taken lower down the river. The soils were well spread over their respective discs, compacted to an equal extent as far as possible, and water was run on. It was found that water ran through the centre funnel at a much more rapid rate than through the others. The soil at Wye Bridge was therefore coarser than that above or below, and more permeable to water. This observation was readily connected with the well-known fact that in winter or after heavy rain the fields above or below the bridge were liable to lie wet for a long time, whilst at the bridge the land remained dry.

Two reasons could therefore be given why the village should have been built on its present site. The shallowness or narrowness of the stream, and the hard pebble bottom made a good place for a ford; while the permeability of the soil made the site dry and healthy.

Behaviour of Clay and Peat towards Water.

Experiment 76.—Fill a small jam jar or beaker with clay rammed tightly in. Scrape away the excess with a ruler, leaving the surface quite smooth and flush with the edge of the pot. Allow water to drip on to it for several days; the clay is found to swell, and force its way out of the vessel. It is evident, then, that clay increases in volume when it becomes wet.

Experiment 77.—On drying, the clay shrinks. Beat some clay out to form a thin sheet, lay it on a slate or piece of board, trim off the edges to form a square, and mark the outline on the board with ink or chalk. At the end of a few days the shrinkage is clearly indicated; it takes place in all directions, and cracks appear quite frequently.

Experiment 78.—To show the marked difference in this respect between clay and sand, try the above experiment with sand. Practically no shrinkage takes place.

Other instances of the shrinkage of clay when water is lost by evaporation are not uncommon. Bricks and other clay articles have to be made larger than they are actually wanted, because during the baking process water is given off, and a decrease in volume takes place. In clay districts fields crack in hot summer weather, sometimes quite large cracks are produced. When a level field behaves in this way in summer, one can predict with tolerable certainty that it will be covered with water during the winter.

Experiment 79.—Repeat Experiments 76 and 77 with peat, but take care that the peat has not become dry, or there may be some difficulty in moistening it again. If the peat is somewhat wet when packed into the jar, it will take up more moisture with readiness.

This experiment illustrates the danger of an undrained peat bog. After a period of heavy rain the peat may swell to such an extent that the bog overflows, and may do considerable damage. The mud streams of the northern moors in olden times before drainage was introduced, and the overflows sometimes occurring even to-day in Ireland, are instances in point.

Capillary Rise of Water in the Soil.

The rain falling on to the surface of the soil will either run off into ditches, or remain in pools till evaporation is complete, or it may sink into the soil. In the latter case some of the water may travel underground on a bed of rock or of clay, and give rise to a spring at a distant point; but a large part is drawn again to the surface of the soil in consequence of what is generally spoken of as the surface tension of the film of liquid. Probably the main portion of the water necessary for the plant reaches it in this way.

Experiment 80.—Fill a tube quarter inch diameter and about thirty inches long with dry soil; tie a piece of rag over the bottom to prevent the soil falling out. Stand the tube in water, and note the gradual upward movement shown by the darker colour of the moistened soil. The movement slackens after a time, but does not entirely cease even after weeks have elapsed.

Experiment 81.—The rate at which water rises depends considerably on the size of the particles. Take two tubes of equal length and diameter—those suggested for Experiment 80 answer very well—fill one with fine sand which passes through coarse muslin, and the other with sand which does not. Note that for the first few hours water rises more rapidly in the tube filled with coarse sand, but that by the end of a week it has risen to a greater height in the tube filled with fine sand.

Experiment 82.—Obtain some straight lamp glasses, and fasten two together by means of cement. The most convenient method of doing this is to bend a strip of sheet iron or tin two inches in width so as to form a collar into which the glasses will easily pass, to slip this round at the part where the two ends meet, and to fill the intervening space with sealing-wax or Faraday's cement. Two of these double-length tubes are wanted.

Faraday's cement is made by melting five parts of resin and one of beeswax, then stirring in one part of red oxide of iron. Mix well and keep molten for some time. It keeps indefinitely, and forms an excellent material for joining glass to wood or metal.

Fill one of the tubes so prepared with soil which has been allowed to partially dry in the air, and ram the soil tightly in with a cork fixed on to a glass rod. Fill the other with some of the same soil lightly placed in and not packed at all. Tie up the bottom end of each tube with calico. Stand the tubes in water; note that water rises more rapidly in the loose soil than in that which has been compacted.

It is an advantage to sow wheat or other seeds in the two tubes. Germination and growth rapidly begin where the soil is somewhat loose, but they are considerably delayed in the other tube.

The experiment teaches the necessity for deep cultivation if a supply of water is to be secured for the plant.

Experiment 83.—The rate at which water rises in the soil of the school garden is readily investigated by making a series of tubes, one a single length, another a double length, a third a quadruple length, filling all with soil, standing in water, and sowing seeds. The rise of water is indicated by the change in colour, and also by the time required before the young plant issues from the soil.

Water rises to very considerable heights in soils. Cases are not infrequent where the water table is about 100 feet below the surface, and yet a sufficient supply is obtainable by the plant. If, however, the rate of evaporation is greater than the rate of supply by capillary rise, the soil will dry out and the plant wilts.

It must also be remembered that percolation is only a slow process, and a considerable time may elapse before the water supplied by a shower of rain passes out of reach of the roots.

Evaporation of Water from the Soil.

It has been found at the Rothamsted Experiment Station that about half the water falling on to the earth as rain evaporates without percolating through twenty inches of soil. Evaporation goes on partly from the surface of the soil, and partly from the interior. It is a serious drawback in gardening, and many of the operations of tillage have for their object a decrease in the rate at which it takes place.

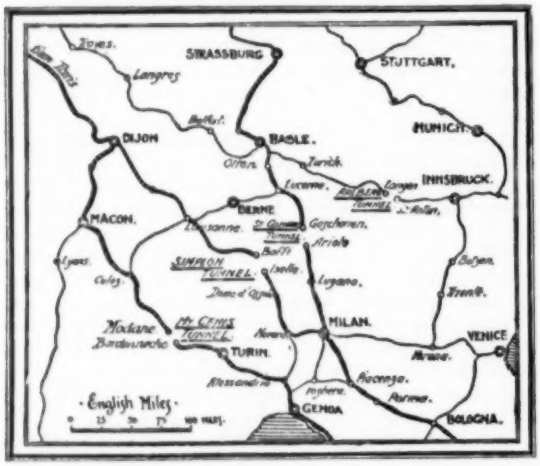
THE GREAT ALPINE TUNNELS.

BY WALTER H. BREEZE, F.R.G.S.

The St. Gothard.

THE St. Gothard Railway connects England, Holland, Belgium, North-Eastern France, and Western Germany with Italy. The line traverses a region of magnificent natural attractions, a district of gorges, and torrents, and snow peaks, and chalets, and

Map shewing the Great Alpine Tunnels:-



heights inaccessible to human footstep; ravines wilder than ever painter put upon canvas; peaceful, populous, fertile valleys—slumbering 'neath the shadows of giant rocky ranges; slopes where thousands of cattle browse; caverns which you may penetrate only to emerge into more dazzling sunlight beyond; lakes bluer than azure and fringed with growths that are green for ever. All this and more may be seen by the traveller as he journeys from the beautiful shores of Lake Lucerne to the picturesque Italian lakes so beautiful for situation.

The entire line, from Lucerne and Zug in Switzerland to Chiasso in Italy, measures 172 miles, and was constructed in ten years—from 1872 to 1882—at a cost of upwards of £10,000,000. For eight years an average of 10,757 men were daily employed on the railway. There are, exclusive of tunnels, no less than 1384 artificial structures along the line, 324 of them being bridges and viaducts of over 30 feet in length, which cross roaring torrents, span mighty chasms, scale dizzy heights, and form one of the most remarkable engineering triumphs of modern times. In the development of the mountain footpath into the solidly constructed, granite-bedded railway may be read the whole story of the growth and progress of science and civilisation.

Route.—From Lucerne the railway runs to Kussnacht, thence skirting the shores of Lake Zug to Brunnen and Fluelen, the latter town being situated on the Uri end of the Lake of Lucerne. From Fluelen the railway follows the Valley of the Reuss, passing Altdorf, a typical Swiss town, in whose market-place tradition places the apple scene between William Tell and Gessler.

At Erstfeld the mountain locomotives are attached, and the long ascent begins—through narrow gorges, along giddy precipices, and amidst scenery sublime in its awfulness. After passing Gurtnellen, Wassen is reached, where the line rises 115 feet in a spiral tunnel. The line here forms two loops, so that at the highest point two sets of rails may be seen below. At an altitude of 3640 feet above sea-level the St. Gothard Tunnel is entered at Goschenen.

The Tunnel.—The St. Gothard is 9½ miles long, and connects Goschenen with Airolo, passing just 1000 feet under the mountain village of Andermatt.

It was commenced at Goschenen on June 4, 1872, and at Airolo on July 2, 1872, and the work was completed in 1882. The tunnel has double rail tracks, being 26 feet wide and 20 feet high, and the cost of construction amounted to £2,240,000. At each kilometre of distance is a burning lantern, numbered successively 1 to 14. The ventilation is good, the temperature seldom rising above 68° F.

This gigantic undertaking was conceived by M. Louis Favre, who, however, did not live to see its completion, as he was suddenly laid low by death while inspecting the interior of the tunnel on July 19, 1879. A beautiful statue has been erected to his memory at Airolo.

The Mont Cenis Tunnel.

This tunnel connects the south of France with the north-east of Italy, joining the town of Modane with Bardonneche. It is 8 miles long, and was constructed by Messrs. Grattone, Grands, and Sommelier in thirteen years—from 1857 to 1870—at a cost of £2,600,000. The tunnel is 13 miles west of the Mont Cenis Pass, over which the famous road was made by Napoleon from 1802 to 1810.

The scenery on the Italian side is extremely grand, rivalling that of the St. Gothard route, the line for some distance being carried along the side of a steep mountain, high above villages, fields, and rivers.

The Arlberg Tunnel.

The tunnel is situated in the Austrian Tyrol, running from Langen to St. Anton, and thus connects Innsbruck with Zurich.

It was commenced in 1880, and was completed in three years at a cost of £1,500,000. Its total length is 6½ miles and its altitude is 4300 feet. The experience gained in the construction of the two previous Alpine tunnels proved extremely valuable to the engineers. Hydraulic power was substituted for compressed air, and the daily rate of advance was nearly twice that of the St. Gothard.

The Simplon Tunnel.

A convention between Switzerland and Italy, to construct a tunnel under the Simplon, was signed at Berne on November 25, 1895.

The work was commenced at Baffi in the Rhone Valley, two miles east of Brig, and at Iselle on the Italian side, on August 15, 1898, and the tunnel was completed and the ordinary passenger service inaugurated on January 25, 1906. The formal opening took place on Saturday, May 19, in the presence of the King of Italy and a distinguished assembly.

The Simplon is the longest tunnel in the world, its exact length being 12 miles 458 yards. A new railway, 11½ miles long, connects Iselle with the town of Domo d'Ossola. This proved to be a very difficult and costly undertaking, owing to the necessity for the construction of a large number of tunnels and bridges.

At the present time the Simplon consists of a single track, although a smaller tunnel has been constructed parallel with it at a distance of 56 feet, connected by transverse galleries, and is now used as a ventilating shaft; but, should it be found necessary, it could be completed and used as a second tunnel in four years. Both steam and electricity are used as motive power for the passage of the tunnel—the southern-bound electrically hauled train making the journey in 18 minutes, while the north-bound steam expresses take from 25 to 28 minutes.

Through the Tunnel.—Mr H. G. Archer, the well-known writer, thus describes the passage of the tunnel from Domo d'Ossola to Brig:—

"Every window is closed, and in the dining-car the temperature soon reaches an appalling height—indeed it often attains 95° Fahr. The heavy train toils up the ascent like the rhythmical beating of muffled drums. The windows are enveloped in an opaque mist. One experiences a pressure on the ears. Now one realises that the train is in a tiny drain-hole, with the solid mass of Monte Leone 7000 feet above the roof, and that during construction the awful weight of the mountain was such that it threatened to crush galleries and workmen alike, and did actually crumple up the most solid iron constructions which were used as supports. One remembers the stories of the hot and cold torrents which poured out of the inmost recesses of the mountain, and annihilated everything which came in their way. Is science sure of its conquest, or are the genii of the Alps about to inflict some terrible ravage upon the mortals who dare thus to journey through their vitals?

"In the suffocating, Turkish-bath-like atmosphere, in the subdued light, perspiring waiters dump food before diners whose appetites have left them.

"A reverberating roar and the flashing of green signal lamps notifies that the train has at last reached the level stretch utilised as a crossing-place on the summit. Windows are hastily opened, and a great sigh of relief goes up as refreshing draughts, untainted by smoke, circulate through the car.

"Quickly gathering speed, the train rushes down the incline towards the northern exit. Steam being shut off, glimpses of the unlined walls of the tunnel, the openings of the transverse galleries that communicate with the parallel shafts, and the electric signals, are obtained.

"Finally, the train emerges into daylight, and for some few seconds the eyes are dazzled by the sunshine and foaming glacier water of the Rhone, which races the train into Brig station."

Tunnelling Mont Blanc.

A scheme for shortening railway communication between Paris and Italy, which is to compete with the Simplon and St. Gothard routes, has recently been prepared by the French Minister of Public Works.

The plan provides for the construction of a tunnel through the Col de la Faucille between Louis-le-Saunier and Geneva, and the French Parliament will be shortly asked to subsidise the scheme. But the Faucille Tunnel is only part of a gigantic scheme for piercing Mont Blanc, and must of necessity occupy many years. The smaller project, however, may be undertaken for its own sake, and independently of the Mont Blanc plan.

The continuation of the Faucille line to and through Mont Blanc would be merely a matter of time and money. As for the cost, it is believed that Italy, which would be benefited by the opening of the Mont Blanc route, would undertake part of it.

A tunnel through Mont Blanc would provide the shortest route between Northern Italy and Paris. French engineers and commercial men predict that, without the new route, which the Minister is about to advocate, the St. Gothard and Simplon lines will ultimately deflect traffic to the Rhenish districts of Germany and the German cantons of Switzerland.

A New Tunnel under the Bernese Alps.

Details of an important project for a trunk line called the "*Lotschberg*," with electricity as motive power, to pass through the Bernese Alps and connect at Brig with the Simplon, are just published. The new railroad will require 5½ years to build, and necessitates a tunnel 13½ kilometres long out of an entire length of 56 kilometres. The cost will be over £3,000,000. It will serve as the most direct means of communication between Northern Italy (Milan and Genoa) and the vast district lying to the north and north-west of Switzerland. It will shorten the approach to the Simplon, that now must be reached *viâ* Lausanne, and will compete with the St. Gothard Railway. In addition to its value as an international trunk line, it will prove of vast commercial importance to Central Switzerland, and particularly to the canton and city of Berne, by affording a direct line with the south. Paris will be 15 miles nearer the cities of Italy than *viâ* the Lausanne-Simplon route, and about 100 miles nearer than *viâ* the St. Gothard. From Calais, Northern Italy can be reached with 52 miles less travel than by Lausanne, through the Simplon.

Summary.

Tunnel.	Location.	Length.	Altitude.	Cost per Yd.	Total Cost.	Date of Completion.
		Miles.	Ft.	£	£	
St. Gothard	Goschenen to Airolo	9¼	3788	142	2,240,000	1882
Mont Cenis	Modane to Bardonneche	8	4298	224	2,600,000	1870
Arlberg . .	St. Anton to Langen	6¼	4300	108	1,500,000	1884
Simplon . .	Baffi to Iselle	12¼	2310	139	3,000,000	1906

CHILDREN'S EXCUSES.

"PLEASE sir, I couldn't help it." Such was the excuse in answer to the question, "What are you doing there?" uttered by a boy who was climbing a wall. Of course, the first point that strikes one is that the reply does not answer the question; perhaps, if it had, the writer would not have been so exercised in his mind over the general question of the replies that children acquire the habit of giving. We say purposely "the habit," for an investigation showed that this boy habitually said that he could not help doing the wrong with which he was at any time charged. Some boys habitually use the phrase, "I'm sorry," when spoken to, and indeed to such an extent has the use of this phrase become a habit that when a teacher says, "Just lend me your book," the boy will reply "I'm sorry," as he hands the book to his teacher. In such a case the teacher should seize the opportunity of pointing out that although the pupil should feel sorry if he has done a wrong, yet in a case like this he should feel pleased.

There are, perhaps, few occasions when the tact and judgment of a teacher are more called into operation than when dealing with the excuses given by offending children. On the one hand, if the excuse is true and reasonable it should always be accepted. In judging a case a teacher should remember that all too frequently he is prosecutor as well as judge and jury, and he should always endeavour to give a decision which would stand the test of an appeal to a higher authority. It is a very unjust and tyrannous form of trial which does not allow the accused to speak in his own defence. Yet we have heard of teachers whose sense of justice is so deficient that they actually make it a practice to inflict double punishment on a boy who offers an excuse for his conduct. This kind of "justice" is suitable only for comic opera, and is quite foreign to the British spirit of administration of justice, although we have heard of a bench of small-minded magistrates not many miles from London, whose practice was to impose a fine of five shillings on all bicyclists who pleaded guilty of "scorching," and ten shillings on those who pleaded not guilty.

Now, although justice requires that every excuse which is true and reasonable should be accepted, yet if the teacher does not take the trouble to satisfy himself that the excuse is true and reasonable, he may be doing great harm to the pupil in accepting it. To accept, without question, an excuse which is evidently untrue is to encourage the pupil in lying, and to bring him up in habits of falsehood. Now, while the best policy is to give each child credit for truthfulness, unless he has been found guilty of telling or acting an untruth, yet the relations between the teacher and the pupil are of such a kind that it is generally easy to investigate any doubtful excuse, and at the same time show no signs of suspicion. In the more serious offences against school discipline, such as absence or lateness, it is usual to require a note from the parent. Unfortunately, there are cases in which the parent's note is not true, and the teacher is then in an extremely delicate position. In any case let the child be removed from the question. He should not suffer for his parent's fault. If the matter is one that can be settled by the Attendance Committee or other outside body, it should be referred to them; but there are times when the teacher feels he cannot go behind a parent's note, although he is satisfied in his own mind that it is untrue.

But not only should the excuse be true, it must also be reasonable; and in dealing with an unreasonable excuse, the teacher has a splendid opportunity of training his pupil in the habit of studying both sides of the question. In these cases, too, he can use questioning which is "Socratic" in the true sense of the word. Unfortunately, certain books on school method have used the term "Socratic" questions for all interrogations employed in teaching; but any one who is familiar with the life of Socrates, and with his conversations as recorded by Plato and by Xenophon in the *Memorabilia*, will know that the essential characteristics of Socrates' method were the detailed analysis of the subject and the way in which the self-confident had their conceit taken out of them. The severity with which this treatment is used will depend upon the frequency with which the offence has been committed; a single lapse on the part of a pupil whose character is known to be highly moral, should not be so hardly dealt with as the recurring act of the shifty offender. The following are some of the most common excuses that teachers accept without question, and the treatment here given will be suggestive of the way of dealing with others.

Lost books or lost pens are given as excuses for not doing homework. The teacher should lead the child to see that the excuse is simply an admission of carelessness in dealing with the books, and, moreover, that if it were accepted, any pupil who wanted to shirk the work could do so by the simple process of losing his books, if once the teacher agreed to excuse the work of those who lost their books.

The statement that "too much homework was set" is often given as an excuse for doing none, or for doing a small portion badly. The teacher must be quite sure on his side that the amount has not been excessive; but he will generally find that the excuse never comes from the earnest pupil, no matter how dull and slow he may be, but from lazy ones, who ought to get through the work in a very little time. Such pupils should be asked how long the exercise or sums took them, and then told that this excessive time on their part proves the need of practice, and that really the amount of work ought to be increased, in order to give them more practice.

Sometimes a pupil who knows nothing of his work in the morning, assures his teacher that he "knew it perfectly last night." It should be deduced from such a boy or girl, that the test of perfection in knowing is ability to remember, and that the fact of his knowing nothing about the work in the morning shows that he did not "know it perfectly last night."

Children who come late frequently assert that they "started at the usual time." These should be led to see that if they started at the usual time and came at the usual rate they would arrive at the usual time. When they admit this they will be forced to admit one of three conclusions: (1) That they are usually late, and previous early marks are incorrect; (2) that they must have dawdled on the way; or (3) that their original statement is incorrect or untrue, and they did not "start at the usual time." G. C.

Letters to Teachers.

The following are some of the curious communications received by teachers in the public schools in Philadelphia:—

Teacher, I dink you are a fool, you want my boy to read when he don't no no alferbits. Please teach him sume.

Teacher, Please excuse Rachel for being away those two days her grandmother died to oblige her mother.—Mrs. Renski.

Teacher, You must excuse my girl for not coming to school she was sick and lade in a common dose state for three days.

Teacher, John says you want to see me. I have a bier saloon and nine children. Bizness is good in morning and aft noon. How can I come?

Teacher, If Louis is bad, please lick him till his eyes are blue. He is very stubborn. He has a great deal of the mule in him—he takes after his father.—Mrs. P.

Miss, My boy tells me that when I trink beer der overcoat from my stummack gets too thick. Please be so kind and don't interfere in my family affairs.—Mrs. C.

Miss Brown, You must stop teach my Lizzie fisical torture she needs yet readin and figors mit sums more as that, if I want her to do jumpin I kin make her jump.—Mrs. Canavowski.

Miss Blank, Please excuse my Paul for being absent he is yet sick with Dipterry and der doctors don't tink he will discover to oblige his loving aunt Mrs. ——. I am his mother's sister from her first husband.

Teacher, What shall I do mit Charley? Me and my man can't nothing make of him. When we want to lick der little imp he gets the bed far under where we can't reach for him, and must put a hook on der bedroom door to hold him for his licking. Please soak him in school shust as often as you got time.—Mrs. Snedivelt.

—*School Board Journal, U.S.A.*

THE BISHOP OF SALISBURY ON THE EDUCATION QUESTION.[1]

AS one who has devoted a great amount of time and attention to education in his diocese, the Bishop of Salisbury naturally has much to say on the Education Bill. The views set out are, as one would expect, the views of a strong partisan; but in spite of that there is a great deal in this little collection of addresses which will interest all who are concerned in educational work, while to some it will give encouragement and to others questions to answer in the conflict which is raging over the education question. The book before us opens with the synod address delivered by the Bishop on the 25th of April last, and in it he shows "the value of the dual system of elementary education." This is introduced by a very gloomy view of the future state of England if the Bill passes. We are told that "France has now ceased to be, even in name, a Christian nation." But surely the "nation" is not made Christian by the fact that the salaries of ministers are paid by the State, and if so, then either the statement so frequently urged that the English Church draws nothing from the State is untrue, or else England at the present time cannot be numbered among the Christian nations. We think, too, that the writer goes further than the case warrants in saying "The Bill which is in our thoughts is not merely an attack upon our Church schools, and the whole system of religious education, but it is a trial of strength upon the question of disestablishment." The address goes on to quote criticisms on the Bill, and affirms that "it abolishes the true system of management and teaching, and substitutes for it a less worthy and efficient form, State or municipal management. It substitutes, in fact, instruction for education, an intellectual for a moral and spiritual process." Then comes the answer to the question, "What is meant by a true system of education?"—an answer which deserves to be preserved among the definitions given by the great educational reformers.

"By education we mean the intelligent formation of character, so that the child shall learn to be his best self in every part of his nature. We believe that to attain this end the system of education must be penetrated by religious motive, regulated by religious principle, and directed by religious conviction. We believe that education is a whole, as man is a whole, and that it does not consist of two different kinds of instruction, secular instruction and religious instruction, the latter being a separate adjunct which may be dispensed with. We believe that both managers and teachers should be religious people, belonging to a religious Society or Church, and knowing why they do so, and that the system of teaching should be so framed as to promote religious and moral ideas, not to neutralise them."

But, we ask, does the Education Bill propose to abolish education as thus defined? We quite fail to see any such attempt. It is true that the word "religious" is somewhat ambiguous, and that while some are claiming "religious education" for all children, they really ask for instruction in their own dogmas. But if we consider, with St. James, that "Pure religion and undefiled before God and the Father is this: To visit the fatherless and widows in their affliction, and to keep himself unspotted from the world," then we quite fail to see how religious education is imperilled by the Bill. With regard to management, we all know the saying that the best government is that of a benevolent tyrant, and those who know the Bishop of Salisbury and what he has done for education would be quite content to have the management of schools in such hands as his; but unfortunately the mismanagement of schools has been, to say the least, quite common enough to justify the desire for a change, especially as a change has come about in the way of raising the money for maintenance.

The Bishop directs his chief opposition to the first clause, and urges that the dual system should continue. We need not here repeat the arguments that were used in demolishing the proposals to amend that clause when the Bill was before the House of Commons. In fact, from a controversial point of view the addresses lose much from the fact that they were delivered before the House of Commons debates and are published after; but we can heartily recommend our readers, to whichever camp they belong, to read these four speeches.

[1] The Education Question, an address and three lectures delivered by John Wordsworth, D.D., Bishop of Salisbury. Longmans, Green and Co. Price 1s.

MR. PERCY BREBNER—more widely known as "Christian Lys"—has nearly ready for publication, through Messrs. Frederick Warne and Co., a new novel, "The Crucible of Circumstance." Hitherto his stories have been mainly concerned with modern mysteries, but in his latest work he gives us a study of character and morals, in connection with the evolution of a gifted actress and singer, Olive Vaughan, from the Lambeth factory girl, Clara Farrow.

The Practical Infant-School Teacher.

THE LITTLE HUSBANDMAN.

Words by JANE TAYLOR. *Music by* THOS. J. HEWITT.

Tempo di Marcia.

f

Brightly. Key D.

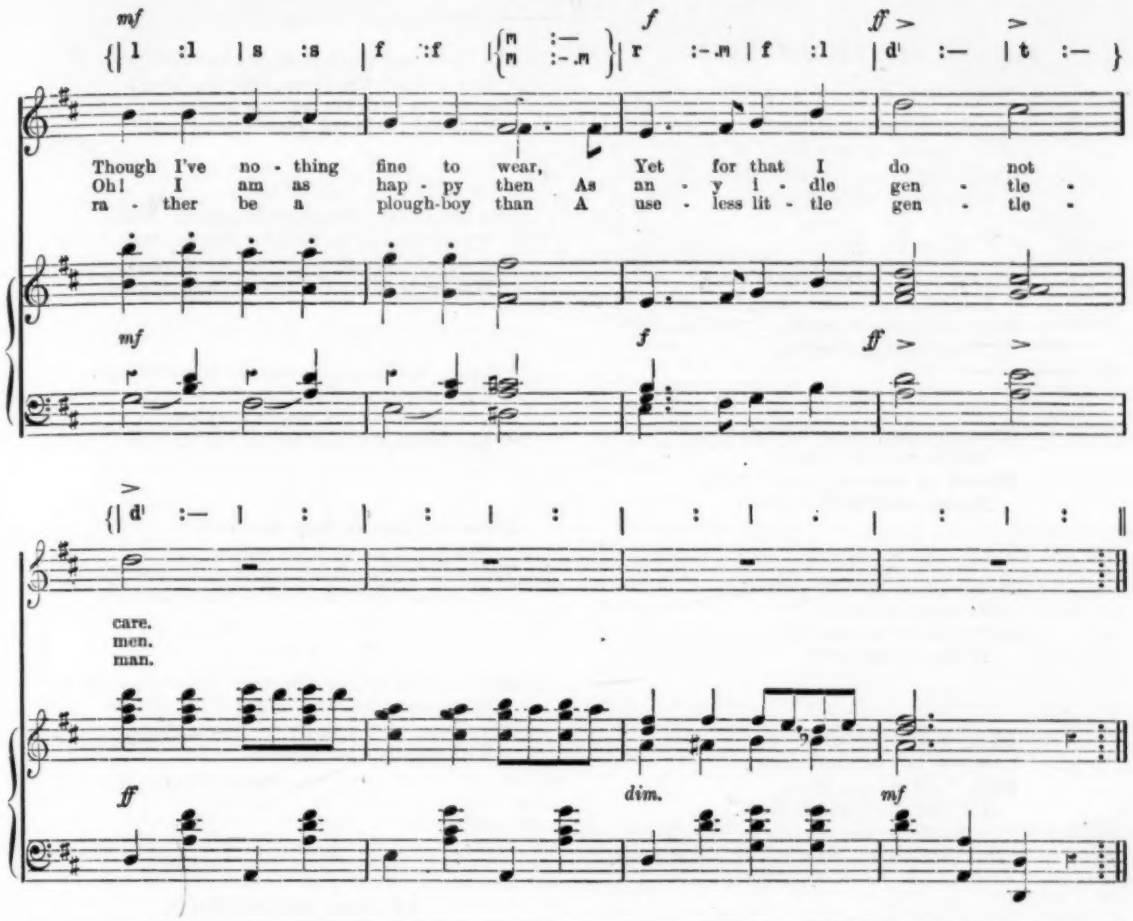
f

1. I'm a lit - tle hus - band - man, Work and la - bour hard I can.
2. When I go to work a - long, Sing - ing loud my morn - ing song,
3. I've a hear - ty ap - pe - tite, And - I sound - ly sleep at night,

f

A. t. f. D.

I'm as hap - py all the day At my work as if 'twere play.
With my wal - let on my back, Or my wag - gon whip to smack;
Down I lie con - tent and say, "I've been use - ful all the day; I'd

dim.

Though I've no - thing fine to wear, Yet for that I do not
Oh! I am as hap - py then As an - y i - dle gen - tle -
ra - ther be a plough-boy than A use - less lit - tle gen - tle -
care.
men.
man.
dim.

ORIGINAL NATURE-STUDY RECITATIONS FOR INFANTS.

FLOSS.

1.

FLOSS was a very naughty cat,
I'm sure you'll not deny it;
She poked her nose in everything,
As soon as she could spy it.

2.

If any one was knitting fast,
The ball would disappear;
And Floss would twine it in and out,
In a manner which was queer.

3.

Her scent was keen as it could be
For meat, fish, fowl, or rabbit;
She took things from the pantry shelf
Till it became a habit.

4.

She scratched the table legs and chairs
Just when they had been polished;
And Uncle Robert's garden plants
By her were quite demolished.

5.

One day she went to Farmer Green's—
She often paid a visit;
And ate a nice fat chicken there;
She thought he would not miss it.

6.

Then on a water-butt she climbed,
It did not take a minute;
She lost her balance—toppled o'er,
And so was drowned within it.

PRETTY LITTLE SQUIRREL.

1.

PRETTY little squirrel,
Started up one day;
Peeped from out her snug hole,
Scampered fast away.

2.

Thought she, "It is spring-time,
Brightly shines the sun;"
That was quite an error,
March had just begun.

3.

Then she sought her larder,
Full of nuts so sweet;
Picked up some big round ones,
Found them quite a treat.

4.

Next she scampered quickly
For another look;
Snow had fallen thickly
In that quiet nook.

5.

She got quite a shiver,
When she saw the snow;
Said, "I'll sleep a little,
Till the warm winds blow."

MISS MERCY BRIERLEY, L.L.A.,
Head Mistress, Peel Street Council Infant School, Morley, Leeds.

SNOW FAIRIES.

SNOW, people say,
Is but the way
Feathers are sent to town;
Snow Fairies know
This is not so;
They from the clouds come down.

Sometimes they dance,
Sometimes they prance,
Sometimes they try to fly;
But if the sun
Sees all their fun,
They melt away and die.

—SISSIE TURLEY BUTLER.

THE WONDERFUL MOTHER.

1.

A WONDERFUL mother is living—
So old and yet beautiful still;
We call her the great Mother Nature;
You see her by mountain and rill.

2.

The birds and the beasts are her children;
The flowers, the ferns, and the trees;
The insects and fish call her mother,
The rocks and the great lonely seas.

3.

She loves them, and cares for them dearly,
While they work hard all the day long;
The flowers and the trees do their duty,
The birds cheer the rest with their song.

4.

"Sleep, children," she says in the evening;
Then big brother Sun moves away,
To give place to his beautiful sister,
The Moon, to take charge till the day.

5.

These children all help one another;
Not one of them lives without aid:
The clouds bring the rain from the ocean,
The trees lend the birdies their shade.

6.

And when they have finished their life-work—
Sometimes it is only a day—
They turn with a smile to their mother,
And quietly vanish away.

—SISSIE TURLEY BUTLER.

LITTLE RAINDROPS.

Flowers.

ALL the thirsty little flowers
Welcome the refreshing showers;
They have waited many hours
For the little raindrops.

Leaves.

Thirsty little leaves will be
Very glad when rain they see;
For they droop so wearily,
Waiting for the raindrops.

Rivers.

And the rivers going by
Murmur sadly with a sigh,
"Wells and Springs will soon be dry
If you tarry, raindrops."

Animals.

Beasts and birdies seem to call
To the raindrops as they fall:
"We are glad to see you all,
Pretty little raindrops."

—SISSIE TURLEY BUTLER.

Our Modern Language Section

FRENCH PRIZE COMPETITION.

RULES.

1. All translations should be **posted not later than October 8th, 1906**, and addressed:—PRIZE EDITOR, Office of the *Practical Teacher*, 35 and 36 Paternoster Row, London, E.C.
2. Competitors should cut out and send the Coupon which appears on the Back Wrapper page of the current number.
3. Competitors should write pseudonym only on MS. Prize-winner will be asked to send name and address for publication.
4. No competitor may take the prize offered more than once in three months.

A Prize of Half a Guinea is offered for the best rendering into English of the following extract:—

La bourgeoisie se dérobe volontiers aux charges de la paternité et aux fonctions sociales; elle bannit l'enfant du logis, l'oublié au couvent ou au collège. Elle se fait d'abord remplacer par des bonnes, puis par des universitaires, bonnes à redingotes ou à diplômes. Elle est habituée à pouvoir, avec de l'argent, se décharger de toutes les besognes. Pourquoi pas de la besogne éducative? Et si la confiance en leur richesse démoralise les parents des élèves payants, la confiance en l'Etat démoralise aussi les parents des élèves boursiers. Ceux-ci s'imaginent généralement que l'Etat les a déchargés de toute responsabilité, et *doit* à ses boursiers non seulement l'entretien, mais le succès aux examens, le triomphe dans une carrière, etc. Aussi, s'il faut que l'administration universitaire, pour réveiller les responsabilités engourdies, donne moins de bourses complètes, et force les parents, quand ils le peuvent, à s'aider eux-mêmes, nous devons nous en féliciter comme d'un excellent moyen de combattre l'universelle indifférence. Pourtant, tous les parents ne considèrent pas le lycée comme une maison de débarras, tous ne sont pas comparables à cet officier supérieur, qui pendant toute une année, fit régulièrement chaque soir au café sa partie de piquet avec un sympathique partenaire, qu'il découvrit enfin comme le professeur de son fils . . . en le voyant sur l'estrade de la distribution des prix. Il y a aussi ceux qui coopèrent trop. Tels sont ceux qui entretiennent chez leurs fils une émulation jalouse ou un surmenage insensé, les parents de "bêtes à concours" ou de "petits prodiges."

From "Maîtres et Parents," by
PAUL CROUZET.

RESULT OF THE SEPTEMBER COMPETITION.

The prize is awarded to "J. M. F." (Will "J. M. F." kindly forward name and address for publication?)

First Class.—Senga, Eicarg, Gwilym, H. J., Keeldees, Gawayn, Agaznog, Phil, Jong, Gladiator, Anston, Tyro, Elsie, Sarum, Paxton Dale, Winnowsty, Comet, Rustica, Nicole, Bobby, Poulard aîné, Nehemiah, Carpe diem, Marcus, Aquina, Lytton, Stonefield, M. L. N., Semper eadem, Eve, Nylmat, Suffragette, M. A. P., Rowena, Ffestin, Fadette, Adolphus, Nita, Ten, Ruthra, Sine cura, White Rose.

Second Class.—Eureka, W. C. W., Siegfried, Cardno, Mervyn, Entente cordiale, E. D., Marie, Alpine, Hazelwood, L. O. V., Stradivarius, Saxonne, Popsy, Max, Cinquième, Ironstone.

The name and address of "T. V. D.," the winner of the July competition, are Dr. Vincent Dickinson, 33 Sloane Street, S.W.

Report.

The translations sent in are of good average merit. Many did not grasp the fact that *que* in *qu'entretenait* is accusative and not nominative, and very many did not realise that *entretenait* is used in the meaning of "kept in his pay." *Clichés* is not used in its exact sense, but in the popular sense of "stock phrases" or "stock jibes." *Tirant les marrons du feu* refers, of course, to the fable of the monkey and the cat, whence we get the English equivalent "making a catspaw of," but a number of competitors did not see this. *Voilà bien les hommes* is also a very idiomatic phrase. "If you want to know men as they really are, you will find them, etc.," well represents its meaning.

Prize Translation.

"Perfidious Albion" is a phrase invented by the pamphleteers, whom Napoleon loyally supported, in order to blacken the character of the royal house and Parliament of Britain. The phrase became popular. It concealed all the blunders that arose from the incapacity or the short-sightedness of our governments in their relations with England. One of the oldest stereotyped phrases of our journalism represents us on various historical occasions "pulling the chestnuts out of the fire" for a greedy and treacherous ally, while with more justice we should have laid the blame on our own inability to perceive, on a given occasion, the real advantages which had escaped us; for example, in the Crimea and in Egypt. We comfort ourselves by abusing a quicker-witted confederate and by crediting ourselves with a higher but somewhat tardy honesty. It makes one think of the saying of Laclos quoted in the following pages: "There you have men all equally unprincipled in their line of action, and they apply the name of probity to the weakness they manifest in the execution of it." Without desiring to confer on England a monopoly which she herself does not lay claim to, we may assert that the desire for and the practice of fair play (a kind of everyday chivalry) and veracity, so prominent a characteristic in modern English education and morality, have permeated political life. J. M. F.

MESSRS. JACK announce a distinct novelty for the autumn publishing season. A number of the most famous poems of all time will be daintily printed in bold type and specially illustrated by a series of pictures by well-known artists of to-day. The booklets will be sold at the same price as the various series at present on the market, which have either no illustrations or merely black and white reproductions. The artists' work in this series will be rendered in the full colours of the originals, and this feature will distinguish these booklets from all others of a somewhat similar kind. Another powerful competitor with the conventional Christmas card will thus be added to those already in the field.

OUR TUTORIAL SECTION

NEW SCHOLARSHIP COURSE FOR 1906-7.

BY ARTHUR T. FLUX,

Late Principal of the Belvedere Pupil Teacher Centre, First on Scholarship List; Author of "Scholarship School Management," "Building of the British Empire," etc.

Work for the Month.

PART I.

1. *Reading.*—Oral practice daily is an essential to success. Vary the subject matter read—essays, newspapers, standard prose works, poetry of all kinds—bearing in mind that the object is always to interpret faithfully the author's meaning by inflection and modulation. Take care with the breathing, inflate the lungs without overcrowding, and without undue fatigue, and expel the breath evenly and without waste. The opportunities for inflection come at the long pauses, and must be utilised. Nothing is more annoying to a listener than to hear a sudden stop and a gasp for breath in the middle of a passage which requires no break. Above all things avoid haste. You must give yourself time to *think* of the meaning as you read, and the eye should be several words ahead of the voice. Do not pitch the voice too high; the ordinary talking tone is the correct one. Above all things, "Do not overdo it."

Read the following several times at different speeds:—

The soldiers steer, the soldier's tear; the presence of man, the presents of man; that lasts till night, that last still night; a languid aim, a languid dame; the woodman's axe, the woodman's acts; the cry moved them, the crime moved them; a never dying fame, an ever dying fame; pray to nobody, prate to nobody; the dews fall on the Jews; proof of utility, proof of futility; he built him a nice house, he built him an ice house.

2. *Recitation.*—Learn the next twenty lines. The advice given for reading applies equally to recitation.

3. *Penmanship.*—Write a page daily in a good copy book, and use great care at all times. Good work cannot be produced without good tools, and it is essential that you use good pens, paper, and ink. The same nib should always be used. I have just marked for a correspondent an essay written with a J pen held sideways, and a copy written with a fine pen in a totally different style. This is obviously ridiculous. No one can suddenly drop an acquired habit and adopt a new one with any immediate success. This subject, notwithstanding the repeated warnings, is still lamentably weak with many correspondents.

4. *Composition.*—The essays submitted for criticism this month are on the whole an improvement on those of preceding months, but the fundamental rules are still frequently broken. You must make out a skeleton form, divide the essay into paragraphs, each dealing with one particular set of ideas, or otherwise there will be confused ideas and endless repetition. If ideas are written down simply as they arise there must be confusion, for not even the most experienced writer can insure the flow of ideas in logical order. This applies, remember, to *all* written answers. Two minutes spent in thinking over an answer, mentally arranging what to say and what to omit, is time well spent. To commence an answer on any subject without this preparatory arrangement, to rush at an answer without due circumspection, is to insure loss of marks.

Continue the exercises on correction of sentences. The following is the correction of the sentences given last month:—

(1) "Unveracious" should be "untrue." "Veracious" is applied to persons, and means "truth speaking," and should not be used about statements or stories. Cf. *true* and *truthful*.

(2) "He breathed his last in indigent circumstances." This is inflated, and simply means "He died poor."

(3) "A quite unique compliment." "Unique" means something entirely different from anything else. A thing is unique or it is not, there are no degrees for the quality, and "quite" is entirely superfluous.

(4) "Driving down the street, his horse ran away." This is an example of the floating participle. There is no word in the sentence to which "driving" refers, the only noun to which it could relate is "horse." Say, "While he was driving," etc.

(5) "He did more for his country than any man living in his time." *He* was living in his time, and therefore he did more than himself. Say "than any *other* man," etc.

(6) "A magistrate can see whether a prisoner is lying better than the jury." "Better than the jury" should come after "see." As it stands it means, "whether a prisoner is lying better than the jury are lying."

(7) "His success is neither the result of system nor strategy," should be, "His success is the result of neither system nor strategy."

(8) "He had promised his father to visit his friends." Whose friends? the son's or the father's?

(9) "Without" is quite superfluous, and if a pause is made after "passengers" the wrong meaning is given.

(10) "I never have and never shall accept" should be "I never have *accepted* and never shall *accept*." "Have" is followed by the participle, "shall" by the infinitive.

Correct the following, and explain the reasons for correction:—

(1) These orders being illegal, they are generally communicated verbally.

(2) The sartorial art is quite as difficult as the culinary.

(3) Anthony was not less desirous of destroying the conspirators than his officers.

(4) The ship was insured for a voyage from London to Gravesend with cement.

(5) On that subject he was literally at sea.

(6) He lent me a quantity of books.

(7) The drug is a palliative, but not a preventative, of fever.

(8) Do you take the medicine that I send you regularly?

Write one or two essays each week on such subjects as:—

(1) The Difficulties of British rule in India.
(2) Courage—physical and moral.
(3) Description of any place visited.
(4) Free Libraries.
(5) British Constitution.
(6) A Citizen's Duty.
(7) Chinese Labour in the Transvaal.
(8) The Foreigner in England.

The following notes may be of assistance:—

(1) To govern India is no light or easy task. It is far from England, it has a climate which enervates the energies of those coming from temperate regions, it is subject to drought and disastrous famines. Socially, the problem is more difficult. India is a conglomeration of states, races, and religions; a law which is fair to one district is unjust in another, a measure which would cause public rejoicing in one instance would lead to a revolt in another. The jealousies of tribes, races, and religions is a source of continual worry; protection of a Hindoo is distorted into oppression of the Mohammedan, and *vice versa*. Native customs such as suttee (burning the dead), juvenile marriages, isolation of women, are most difficult to deal with. We consider as absolutely wrong what the native regards as right, and it is impossible to alter by legislation practices which are injurious. Education may eventually remove them, but this is a process of time. The Pathan acts on the Mosaic law—an eye for an eye, a tooth for a tooth—he is not doing his duty if he does not seek revenge, and until he can be made to see the error of his ways, it is hard to punish. The poverty of the country is also a serious difficulty. Early travellers, who saw some rajah with his robes a blaze of gems, jumped to the conclusion that India was rich, and this opinion has hardly yet died out. India is one of the poorest countries on earth, and a large part of the population of 300 millions is but one meal from

starvation. Politically there are great difficulties, necessitating a large standing army.

(2) Courage is a quality which is universally admired, at least in one form, for it is necessary to define very carefully the exact meaning of the word. To be courageous is to present a bold front to any difficulty or danger, and the varieties of courage are as diversified as the dangers which call it forth. There is a physical courage which enables a man to face physical dangers; he faces wild animals, savage foemen, nearly certain death, with intrepidity. The holder of the common gun-metal cross bearing the words "For Valour" (V.C.) have all been physically brave. The many admire this quality, the man is made a hero. But even here there are degrees—some Victoria Crosses have been won by deeds performed in the heat of action, deeds of which the man is scarcely conscious; others again by men who have acted deliberately and with a full sense of their danger. The man who, at the risk of an ignominious death, successfully penetrates the enemy's country or camp to obtain information for his general, may shrink from the carnage of an open attack. But there is a higher courage than any of these forms—the *moral* courage to speak the truth and fear not, the courage which has faced the fires of martyrdom rather than own itself subdued. The man who is threatened with instant death from disease and yet cheerfully continues to do his duty, the poor woman lying helpless on a bed of suffering from which there is no respite but the grave, yet who presents a cheerful and happy appearance to all her acquaintances—these are heroes, although they are unacclaimed by the multitude. Nor less so is the nurse, the philanthropist, the reformer, who devotes a life to a never-ending fight with dirt, disease, ignorance; Florence Nightingale in the hospitals at Scutari, Father Damien in the Lepers' Island, many a minister in our crowded cities, the missionary in India, China, Africa, and elsewhere, the office boy and street urchin who suffer for what is right—all exhibit heroism of the highest kind.

(3) This is an exercise in pen-painting—describe and do not catalogue. Present as vivid a picture as you can, omitting unnecessary names, details, and statistics.

(4) The object of our libraries may be explained—to put within the reach of every one the nation's best literature, to enable every one to educate himself free of expense. Whether free libraries have justified their existence is a very debatable point. If there were a great demand for standard works, for books on science and technology, we should be inclined to answer in the affirmative, but when the greatest number of volumes asked for consist of fiction—often of the poorest kind—of magazines, of sketches and short tales which do no good other than provide a means of wasting time, when newspapers are consulted for the earliest betting news, then free libraries are doing more harm than good.

(5) There should not be much difficulty with this. Of all the forms of government, the limited monarchy is undoubtedly best. The Commons represent the free voice of the people, the Upper House acts as a check on any too hasty decision of the Commons, and the King, who, according to the law, "can do no wrong," represents the fixity and durability of rule. Autocracy may be best where the masses are ignorant, a republic where all men are equal and absolutely disinterested; but for any civilised country, a lower house of directly elected representatives, an upper house to watch and revise the decision of the representatives, and a permanent head, is absolutely the best form. It might be well to revise the constitution of the House of Lords, to abolish it altogether would be a mistake.

(6) Privileges are always accompanied by duties, and no one has a right to enjoy the privileges accruing from being a citizen of a town or an empire without undertaking some of the duties. One of these is, of course, contributing to the support of the necessities of the community, but to pay rates and taxes is not enough. Every man should take an intelligent interest in local and national affairs, and should do his best to help forward any measure which in his opinion tends to improve the position of the town or the nation. Grumbling at, or adversely criticising, what is being done, is not enough. Destructive criticism is cheap and easy, to construct and improve is more difficult. As a rule, in England, the man who comes forward and offers his time and energies for the benefit of his fellow-townsmen is suspected of some ulterior motive by many. One would think he was applying for a position with a large salary attached, when often he is sacrificing time and money for the good of others. In any election, the number of those who do not vote is sufficient indication of the very large number of men who fail entirely to fulfil their duty.

(7) This is a very difficult subject on which to express decided opinions. Politicians with very pronounced views either bless or curse according to their political creed, but no proper understanding can be arrived at if it is approached with a partisan bias. The following are some points for and against:—

Pro.	*Con.*
1. To develop the great mineral wealth of South Africa there must be an abundance of cheap labour, for the cost of production does not allow of high prices for work.	1. The labour need not be "cheap." If the millionaires and Rand magnates were content with less dividends, there would be enough to pay white men good wages.
2. There is a scarcity of Kaffir labour.	2. Kaffir labour is scarce because they have been treated so badly.
3. Taxation of Kaffirs would be a failure.	3. It need not if properly done.
4. There are plenty of Chinese who are only too glad to come.	4. It is wrong to introduce a large body of aliens who would become a standing menace to the peace of the country.
5. The Chinese are well treated compared with their life in China, and receive much more money for their work. They come voluntarily.	5. The Chinese are cruelly treated and ill paid, hence the crimes committed. They do not know what they are undertaking.
6. Coolies' labour is employed with success in other parts.	6. Yes, under totally different conditions. America and Australia have had experience with Chinese, and their experience has led to the prohibition of coolie immigration.

(8) The foreigner in England does not receive such consideration from the man in the street as the Englishman does abroad. The tendency of the ill-educated Englishman is to laugh at and make fun of the foreigner; in his hide-bound insular prejudice he despises everything foreign. Owing to this, the continental opinion of Englishmen is not flattering. Some amends have been made these last few years; we have welcomed French sailors, French councillors, German editors, &c., in the proper spirit, much to their surprise and delight. Pride in one's country is a natural and excellent thing, but it should not be carried so far as to become insulting exclusiveness.

5. *Arithmetic.*—Proportion by the Unitary or Fractional Method.

Although ratio and proportion are excluded from the syllabus, the student will be acting very unwisely unless he obtains some knowledge of the theory of these rules. Proportion is unintelligible if ratio is not understood. Work as many of the examples as you can in Christian and Collar. The following have been set in examination:—

(1) If a beam 16 feet long, 2½ feet broad, and 8 inches thick weigh 1280 pounds, what must be the length of a beam of the same material whose breadth is 3½ feet, thickness 6¼ inches, and weight 2028 pounds? Ans. 24 feet.

(2) After paying an income tax of 5d. in the £ a person's income was £733, 7s. 11d. What would it have been had the tax been 5½d.? Ans. £731, 16s. 8½d.

(3) An officer, whose pay was estimated in rupees, lost £41, 12s. 6d. in one year by a fall in the value of the rupee from 1s. 11½d. to 1s. 10½d. What was his salary estimated in rupees? Ans. 7992.

(4) Raising the income tax 1d. in the £ increases the amount of tax by £2, 3s. 4d., and the tax I actually pay is £15, 3s. 4d. What is the rate of tax? Ans. 7d. in the £.

(5) A man gives a boy 20 yards start in 100 yards and loses the race by 10 yards. What would have been a fair start to give? Ans. 11⅓ yards.

(6) If 44 labourers can do a piece of work in 15 days of 10 hours each, how many navvies must be employed to do ⅔ more work in 7 days of 11 hours, supposing 3 navvies able to do the work of 5 labourers? Ans. 90.

(7) If an express train, travelling at the rate of 55 miles an hour, can accomplish a journey in 3½ hours, how long will it take a slow train to travel two-thirds of the distance, its rate being to that of the express train as 4 to 9? Ans. 5¼ hours.

(8) A watch, which loses 5 minutes a day, is set right at 9 A.M.; find the true time when the watch indicates 2 P.M. on the following day. Ans. 6 minutes 3$\frac{11}{12}$ seconds past 2.

(9) An agent, collecting rents at a commission of 4$\frac{3}{4}$ per cent., deducted his commission and paid over £741, 1s. 10½d. What amount of rents did he collect? Ans. £775.

(10) Two incomes, one of which is half as large again as the other, pay together an income tax which amounts to £70, 0s. 10d.

If the income tax is 8d. in the £, what is the amount of each income? Ans. £840, 10s.; £1260, 15s.

6. *Drawing.*—One or two freehand copies each week, and one or more group of models. The copies must fairly fill a half imperial sheet of paper. Students must send up work occasionally for criticism, as more assistance can be given by individual criticism than by general advice.

7. *Music.*—Systematic practice must be taken in the Practical Music. *Practical Music for P.Ts.* (Curwen and Co.) is an excellent little book to use.

For this month prepare Tonic Sol-fa Notation, Major and Minor Modes.

For those who have obtained a clear knowledge of the principles of music as written in the Staff Notation, there will be little difficulty in the Tonic Sol-fa.

The questions on the minor mode relate chiefly to the varying forms of the sixth and seventh.

The ancient or unaltered form of the upper tetrachord was **m . f . s . l**, but this ascending is not satisfactory to the ear, as it terminates with a tone. To obviate this the seventh was raised a semitone, and we have the chromatic form, **m f se l**. But this caused another difficulty; **f – se** is an augmented third, and to get rid of this the sixth was raised a semitone, and the modern form is **m bah se l**. Then there are two sevenths and two sixths in the ascending scales.

se . . .	Major Essential Seventh.
soh . . .	Minor Occasional Seventh.
bah . . .	Major Occasional Sixth.
f . . .	Minor Essential Sixth.

Such questions as the following are asked:—

(1) Write an ascending minor scale (lah mode) using the minor sixth and major seventh, and a descending scale, using the minor sixth and minor seventh.

Answer—

l, t, d r m f se l l s f m r d t l

(2) Write an ascending minor scale (lah mode), using the major sixth and major seventh, and a descending scale, using the minor sixth and major seventh.

(3) Name the following relations of the minor or lah mode—(*a*) Dominant, (*b*) minor or essential sixth, (*c*) leading note or essential seventh, (*d*) super tonic.

(4) Which tetrachord of the minor scale (lah mode) never varies? Write the variable tetrachord in three forms, and state which of these forms is exactly like the corresponding tetrachord of the major scale in its intervals.

(5) What is meant by a minor scale "*lah* mode"?

A minor scale commences with a minor third. There are four notes of the scale which have a minor third, **r, m, l, t.** As the interval above **m** and **t** is a minor second they were never used, but **r** was used as the tonic, and is still found as such in old songs. If **r** is used as the tonic of the minor scale, the scale is said to be written *ray mode.* But at the present time it is practically obsolete. *Lah mode* means that the minor scale takes *lah* for its tonic.

PART II.

1. *English Grammar and Literature.*—Work for the month.
   (*a*) Revise the grammar of the Preposition and Conjunction.
   (*b*) Abbott and Seeley—Part II., Chapter III.
   (*c*) Read the *Merchant of Venice.*
   (*d*) Next twenty poems in the *Golden Treasury*, or other good collection.
   (*e*) Read *Windsor Castle.*
   The Armourer's Prentices.

Notes.—(*a*) In each case learn exact definitions and good classifications. Distinguish carefully between the use of a word (*e.g.* "before") as a preposition and as a conjunction.

Conjunctions are classified on two separate bases—(*a*) as co-ordinate or subordinate, according as to whether they join words, phrases, and sentences, or equal rank, *e.g.* and, but, or whether they subordinate one part to the other, and (*b*) according to their meaning, as—

Simple—and.
Adversative—but.
Hypothetical—unless, though.
Conditional—if.
Adverbial—when, where, etc.

In parsing a conjunction, both classifications should be stated, thus—

When—conjunction, subordinate, adverbial, joining, etc.

A common difficulty arises from the fact that the noun governed by a preposition is frequently omitted because it is understood, and other modifying words inserted. *E.g.* "God from on high hath heard;" "From far away we come to you," etc. In such cases a note should be written explaining the exact formation.

(*b*) This chapter in Abbott and Seeley is not only most interesting, but will prove most useful to students who are anxious to improve their composition, for it deals with the mistakes which are most common with young writers. Slang expressions are used so frequently and become so natural that there is a danger of their creeping into an authorised position in the language, and they are frequently used in all innocence. But without being a bigoted precisian, it is possible to relegate these words and phrases to their proper place, and to refuse them admission into King's English. Many catchwords and phrases are utterly meaningless, and it is difficult to understand how they acquire popularity; others are corruptions of phrases and words, either misunderstood or else toned down from something very objectionable, or originate in the name of some well-known man—*e.g.* "Sir Robert Peel" gives us "peeler" and "bobby." Technical slang is adopted in speech in many cases from a desire to show intimacy with manners and customs of different classes of society. Betting and horse-racing phrases, such as "coming a cropper," "taking the odds," are used by people who are entirely ignorant of the race-course.

Fine writing, or rather an attempt at it, is another very common mistake. Students suppose that in their essay they must get on stilts, and use grandiloquent phrases. (The same error has been noticed in Reading, when an unnatural and artificial voice is assumed.) This is not only unnecessary, but positively harmful. The language is sufficiently rich in words to allow of most ideas being expressed in homely Saxon words, which are infinitely preferable to four-syllabled words of foreign origin. This habit of the Euphuists is ridiculed by Scott in the character of Sir Piercie Shafton in *The Monastery.*

Tautology, or saying the same thing twice over, is also common—*e.g.* "advance forward." The student must especially lay to heart what is said of Obscurity and Ambiguity. Children particularly in the early stages of composition use a bewildering profusion of relatives and pronouns—*e.g.* The Earl met the King. *He* said *he* would visit *his* troops before *they* went to fight.

See that you can answer all the questions on this chapter.

(*c*) *The Merchant of Venice* is one of Shakespeare's best-known plays. It consists of three Italian plays adapted and woven together. (1) The story of the caskets; (2) The Jew and the pound of flesh; (3) The elopement of the Jew's daughter. The clever manner in which these three tales become one by making the characters related to each other is an evidence of the genius of the great dramatist. The French critics of the seventeenth century laid down the principle of the "Three Unities" as a condition for a drama—Unity of Time—all the events should occur in the space of twenty-four hours; Unity of Place—the scene should not change from one place to another; Unity of Action—the drama should consist of one tale only. Judged by these arbitrary canons, *The Merchant of Venice* is not a drama at all. Yet of all the plays this is perhaps the most interesting, from the wealth of incident and the number of diverse characters. It is a glimpse of mediæval life as a whole, a crowd of living and breathing men and women, full of the passions of human life—love, joy, friendship, hate, humour, and pathos. The characters are not mere pegs on which to hang speeches. Shylock seems as real to us as Judas Iscariot, Portia as Lady Jane Grey or Anne Boleyn, Antonio as one of Elizabeth's merchants. The play is fascinating, and will amply repay most careful reading.

(*e*) Ainsworth's *Windsor Castle* is not of any value as history, but it conveys much accurate information of the life and manners of the time.

2. *History.*—The reigns of Henry VII. and Henry VIII.

The Tudor period is one of the most important in English history. The changes that took place during one hundred and eighteen years of this dynasty were more productive of important results than those of any period of similar length. They were far-reaching and affected all classes of society, from the monarch to the farm labourer. It is difficult to find any political or social question which did not undergo great changes, and as no change is produced without causes, it is necessary to ascertain these causes.

(I) The Dark Ages were passing away. For fourteen centuries Europe was the scene of continual warfare, Romans against Franks, Goths, and Huns, Germans against French, Moors against Spaniards, to say nothing of the internal civil wars which ravaged every country. The nations were shaking

down into place, *Might* was *Right*, muscle and not brains, was the dominant factor. The feudal system had encouraged, or at least aided this, but the system was doomed. In England, the Wars of the Roses practically destroyed the old feudal barons, and the first Tudor was not faced, as all his predecessors had been, by a ring of armed men, whose voice was bound to be heard. He found the feudal system at its lowest ebb, and kept it there by the statute of Maintenance and Livery. The use of artillery revolutionised fighting.

(2) The revival of learning or Renaissance—the "new birth," was another cause. Naturally, during the Dark Ages learning had been scorned; it was left to clerks (=clerics), and the powerful baron could not sign his name. Only in the quiet scriptorium of the monasteries were to be found thoughtful students who delighted in the classic authors, and made beautiful copies of their works. There were schools and universities, but they were for the few. The rich, engaged in continual fighting, naturally took little interest in the arts—painting, sculpture, and architecture (except ecclesiastical), or in books and reading. But now there was little fighting, and men turned their minds to more profitable pursuits. The wealth of learning of ancient Greece and Rome was still preserved at the capital of the Eastern Roman Empire—Constantinople; but the Turks were hammering at its gates, and when in 1453 they captured that city, the scholars fled with their priceless manuscripts into all the European cities, and each became the centre of a new movement, as it was only by teaching that they could earn a living. Owing partly to this and partly to the relaxation from continual warfare, men's minds turned to the more æsthetic side of life, and great advances were made in painting, literature, architecture of private houses (as many of the stately Elizabethan mansions shall show).

(3) One great drawback to the dissemination of learning was the absence of books. The manuscripts were very costly, as they occupied (some of them) the greater part of a lifetime to complete. The invention of printing altered all this, and enabled books to be multiplied rapidly and at a relatively small cost.

(4) The invention of the mariner's compass enabled sailors to strike out boldly into oceans hitherto unexplored. Diaz doubled the Cape, Vasco da Gama reached India, Columbus discovered America, Cabot the northern part of what is now the United States; and soon mariners of the type of Grenville, Frobisher, Willoughby, Hawkins, Drake, Cavendish were eagerly exploring, finding new markets, and giving an impetus to trade and commerce.

(5) It was an age of new ideas, the mist of darkness rolled away, men read with avidity the classics, and soon there arose such a chorus of English singers as has never been equalled. Spenser, Sidney, Shakespeare, Marlowe, Green, Ford, Massinger, Beaumont, Fletcher, and dozens of others poured forth dramas and songs, redolent of strenuous life and liberty. In prose also, such men as More, Hooker, Bacon, created a style before unknown.

(6) Last, but not least, the northern and western part of Europe threw off the despotism of the Pope and sought a more Christian-like faith.

On each of these topics volumes might be written; the student must read them up for himself.

The chief points in Henry VII.'s reign are:—

1. The cause of Tudor power—a crushed nobility, a subservient church and commons, a desire for peace, and the character of the monarchs themselves.

(2) Henry's means of amassing money.

(3) The plots and risings.

(4) The marriage schemes. Henry was the first monarch to establish diplomacy to the full.

Henry VIII:—

(*a*) The career of Wolsey—noting particularly his policy at home and abroad.

(*b*) The contest with the Pope.

(*c*) The divorce question brought about the downfall of Wolsey and led to the Reformation.

(*d*) The dissolution of the monasteries and its results.

These are most important. With all their faults the monks were the agriculturists, good landlords, and kindly guardians of the poor. When the monasteries were dissolved, the cultivated lands were turned into sheep farms, the newly made nobles were grasping landlords, and the poor, increasing in numbers, were left without any assistance. Hence general agrarian discontent, the Pilgrimage of Grace, etc. These will be dealt with under the poor laws of Elizabeth.

2. The Reformation.

You must be prepared to answer these questions:—

(1) What causes produced the Reformation?

(2) On what points did the Reformers differ from the Roman Church?

(3) What was Henry's attitude to the Reformation?

Henry was *not* a Reformer. He burnt Papists and Protestants at the same stake, the former for denying his supremacy, although they followed his religion; the latter because they disagreed with him in points of belief, although they admitted his supremacy.

(5) What were the results of the Reformation on England?

(6) What was the cause of the battle of Flodden? Describe it, with a plan.

(6) What was the Statute of the Six Articles?

Citizenship.—Chap. ix. Peaker's *British Citizenship*.

The Administration—The Home Office—The Local Government Board.

Special Period.—The early years of Victoria's reign, 1837 to 1845.

3. *Geography.*—Work for the month.

(1) Physical.—Mountains, their uses and distribution.
Tablelands, plateaux, and plains.
The ocean—depth, temperature, saltness, and density.

(2) Prepare in detail Norway, Sweden, and Denmark.

(3) Prepare thoroughly the United States.

In revising the countries set for this month, use sketch maps plentifully; it is the only way in which the exact shape of the country and position of the towns, etc., can be remembered. The industries, imports, and exports, are of first-rate importance. Note carefully the new constitution of Norway. Your text book will probably say that Sweden and Norway are under one king. This is not so, as Norway is now separated from Sweden and has a king of its own, King Haakon.

In dealing with the United States, note the diversity of climate according to the district. (1) Eastern slope; (2) prairies; (3) tablelands; (4) Pacific slope. The enormous mineral wealth, the forests, the fertile prairies, the useful rivers, all tend to make the States prosperous. The form of government must also be carefully noted.

To test your reading, use *Test Questions in Geography* (Meiklejohn and Holden). These questions, selected from examination papers, provide a comprehensive test of reading.

4. *Elementary Science.*

The effects of acids on zinc and iron.
Composition and properties of water.
Action of water on metals.

Your text book will give you all the information needed on these points, but it will be necessary to work many simple experiments to prove each point. An acid is an unstable compound, and readily splits up in the presence of metal. Thus with HCl the Chlorine unites with the metal to form a chloride, setting the Hydrogen free, with H_2So_4 a sulphate is formed and water liberated, etc. The composition of water by analysis and synthesis must be proved.

5. *Elementary Mathematics.*

(*a*) *Arithmetic.*—Averages and percentages. Read up the explanations in Christian and Collar, and work as many of the examples as possible. Select those examples of which you are doubtful, and send up any which present insuperable difficulty for solution.

(*b*) *Algebra.*—G.C.M. by factors. The chapters and examples on factors in Hall and Knight are excellent, and must be closely studied.

(*c*) *Geometry.*—Tangents to a circle, and common tangents to two circles.

(*d*) *Euclid.*—Propositions 48–31, with four deductions per week.

Test Questions.

(*The answers to these can be marked at a nominal charge by arrangement.*)

1. Write as specimens of copy setting:—

(*a*) Large hand.—Denominational.

(*b*) Small hand.—"Denmark" means the mark or territory of the Danes.

2. Work the following:—

(1) Divide $\frac{3}{4}$ of $\frac{7}{8}$ of $\frac{2}{3}$ by $\frac{1}{15}+\frac{2}{3}+\frac{1}{4}$, and explain the reason of the rule for dividing one fraction by another. Ans. $\frac{21}{44}$.

(2) Seven men agree to mow a field in 5 days, working 8 hours a day. At the end of 3 days two of the men leave. How many hours a day must the remainder work to complete the work in the time agreed upon? Ans. 11½ hrs.

(3) Find the L.C.M. of 20, 12, 15, 18, 24; and the G.C.M. of 902, 1368, 1944. Ans. 180, 18

(4) A number is divided by 210 in three steps, the factors being 5, 6, and 7 in order, the remainders are 2, 3, and 4. What would the remainder have been had the order 7, 6, 5 been taken? Ans. 4, 1, 3.

(5) A watch which is set correctly at noon indicates 10 minutes after nine the same evening when the true time is 10. What is the true time when the watch indicates 11 the same evening? Ans. 12 midnight.

(6) A man spent £200. He bought 200 animals, consisting of sheep, pigs, and young geese. For each sheep he gave £5, for each pig £1, and for each goose 1s. How many of each did he buy? Ans. 38 sheep, 160 geese, 2 pigs.

(7) What is the least number which, when divided by 33, leaves 32 remainder? When divided by 37, leaves 36 remainder? When divided by 43, leaves 42 remainder? Explain the process of working. Ans. 52502.

3. Write a brief life of Hamlet as indicated by the play.

4. How would you classify adverbs? Give examples.

5. Write a short life of Warwick, the King-maker, and explain his change of policy.

6. Give some account of the growth of the Constitution under the Lancastrian kings.

7. What causes produced the loss of the possessions in France?

8. Trace any good that immediately arose from the passing of the Reform Bill of 1832.

9. Explain clearly the precession of the equinoxes.

10. To what classes of colonists does Canada present attractive prospects. In what districts would they probably settle?

11. Describe a series of experiments to prove the composition of the air.

12. Trisect a right angle, and prove your method.

All students are invited to write for assistance on any matter connected with this Course. Letters should be sent to Mr. A. T. FLUX, Belvedere, Kent, and must contain the coupon of the current number of the paper, with a stamped addressed envelope if a reply is needed by post.

OUR CERTIFICATE COURSE FOR 1907.

BY GEORGE COLLAR, B.A., B.SC.,

Head-Master of Battersea Pupil-Teacher School.

Test Questions on Last Month's Work.

THEORY OF TEACHING.

1. What are the tests of good reading? Discuss the importance and usefulness (*a*) of pattern reading, (*b*) of silent reading, (*c*) of simultaneous reading.

2. In grouping together a large number of words, having in them a common element, for example, words ending in *-tion*, what generalisation could be made, and how far could the scholars be helped to make the generalisation for themselves? Show the value of such an exercise.

3. Mention some of the breathing exercises that you have employed in connection with the reading lessons.

ENGLISH LITERATURE.

1. In *The Cloister and the Hearth* what light is thrown on the inability of severe punishments to repress crime?

2. Mention some respects in which the poor were worse off in the Middle Ages than they are now.

3. Give an outline of the second act of *A Midsummer Night's Dream*.

HISTORY.

1. Give a brief account of the following battles and their results:—Northallerton, Bouvines, Falkirk, Halidon Hill, and Shrewsbury.

2. Edward III. has been called "King of the Seas." Show how this position was won and lost. What means had he at his disposal for raising a naval force?

3. Give some account of the progress and development of the power of the House of Commons under Edward III., and of the attempts of Richard II. to make himself autocratic.

GEOGRAPHY.

1. Trace the watershed of Europe from Gibraltar to the Ural Mountains.

2. Give a short description of the mountains known under the general name of the "Alps," and show their influence on trade routes.

ARITHMETIC.

1. Show that the product of two numbers is always equal to the product of their L.C.M. and G.C.M.

2. What concrete illustrations would you employ in teaching the rule for division of Vulgar Fractions to children?

3. The L.C.M. of two numbers is 28,035; the only factor of the first not contained in the second is 7, and the only factor of the second not contained in the first is 5. Find their G.C.M.

4. What do you understand by the G.C.M. of two or more fractions? Find the G.C.M. of $\frac{3}{50}$, $\frac{9}{70}$, and $\frac{27}{100}$.

ALGEBRA.

1. Explain the terms: factor, index, binomial, literal coefficient; and describe the use of brackets.

2. Find the value of

$$\frac{a+b}{ab}(a^2+b^2-c^2)+\frac{b+c}{bc}(b^2+c^2-a^2)+\frac{c+a}{ac}(c^2+a^2-b^2)$$

when $a=3$, $b=4$, $c=-5$.

3. Add together

$$6a^3-(5a^2b-b^3),\ 7a^2b-(3ab^2-2b^3),\ 5ab^2-(4a^3+b^3);$$

and subtract $2a^2b-2ab^2$ from their sum.

GEOMETRY.

1. Draw an equilateral triangle ABC, whose sides are two inches long, and then describe a circle passing through A and touching BC in B.

2. Construct a rectangle whose sides are 2 inches and 1 inch. Draw a circle passing through three of its angular points, and prove that it must also pass through the other.

ELEMENTARY SCIENCE.

1. What do you mean by uniform motion and by uniform acceleration?

2. Enunciate Boyle's law. Ten ccm. of air measured at atmospheric pressure are confined in Boyle's tube, the pressure is then increased by means of a column of mercury and the volume is reduced to 5 ccm. Explain, by means of a diagram, how you would determine the pressure of the atmosphere at the time of the experiment by this method.

Notes and Syllabus for October.

ENGLISH COMPOSITION.

Prepare chapters ix. and x. of *The Art of Writing English* or chapters vi. and vii. of Nesfield's *Senior Course of English Composition*. Work all the exercises given.

Write essays on the following subjects:—

1. Comparison between the republican and monarchical forms of government.
2. Happiness.
3. The "Entente Cordiale."
4. Forms of exercise.

PRINCIPLES OF EDUCATION.

Study the chapter on teaching spelling—chapter viii. in the text book.

English spelling is full of inconsistencies owing to the fact

that the language is derived from several sources, and that the words were originally spelt phonetically, and although the sound has changed the spelling has remained the same. Thus we see, for instance, that originally the most usual sound of *a* was that in the word *father*, corresponding to the sound of *a* in other European languages, but now this is seldom used. Again, in such words as "gnaw" and "knife" the initial letter used to be sounded, but it is now mute. Compare *knife* with French *canif*; and we have a clear proof in the early English alliterative poetry, *e.g.* :—

The Kyng and his knightes to the kirke wente.
Piers Plowman, v. 1.

The metre of such a poem requires that the three most accented syllables of each line should begin with the same sound, hence *king*, *knights*, and *kirk*; at one time all began with the *k* sound. It is evident also that there must have been some reason originally for using these letters, which are now mute.

Other cases of alteration in pronunciation can be shown to have occurred in much more recent times; thus *tea* was originally pronounced *tay* (and still is so pronounced in Ireland), compare Fr. *thé*. It was so pronounced in the time of Pope:—

Here thou, great Anna! whom three realms obey,
Dost sometimes counsel take—and sometimes *tea*.
—*Rape of the Lock*.

So also the diphthong *oi* or *oy* was pronounced like a long *i*, as it is still by some country people. In Gray's *Bard* we have the lines:—

With me in dreadful harmony they *join*
And weave with bloody hands the tissue of thy *line*.

Some words have acquired a peculiar spelling from false analogy with other words to which they are somewhat related in meaning; thus the word *rime* is frequently spelt *rhyme* through a confusion with the word *rhythm*, which is of Greek origin. In all such cases it is clearly our duty to keep to the original form, for if we retain the initial *k* in *knife* on historic grounds, the same argument must be used when simplification is demanded. This argument also supports such spelling as *honor*, *labor*, which are often regarded as Americanisms, but which are after all the original forms of the words. Owing to the action of President Roosevelt in requiring the Government clerks in United States public offices to adopt certain reforms in spelling, a considerable amount of public attention has been directed to the subject, and the student will be well advised to make notes of all the arguments used in the papers both for and against spelling reform.

English Literature.

Read Shakespeare's *Merchant of Venice*. This play affords intense enjoyment, whether it be read or acted, and perhaps at the present time, when religious toleration is growing more common, people are becoming more able to appreciate this wonderful play. We see in this the effect of persecution; it leads to a desire for revenge. How can a man who lives in constant fear of being burned alive, plundered, banished, and spat upon, be expected to be forbearing, or to have much of the "milk of human kindness" for his persecutors? Even when they come to ask a favour they show no inclination to relent, and in reply to Shylock's complaints, Antonio answers—

"I am as like to call thee so again,
To spit on thee again, to spurn thee too."

The trial scene is universally regarded as a masterpiece of dramatic art. Shylock undertakes his own case, and is successful all along the line until his case fails through a little legal flaw. Except for that his position is legally sound, and, if judged by the standard of the other characters, it is morally correct. Besides the passages dealing with the desire for revenge, the student should collect those that show Shylock's descent and origin, his thrift and domestic economy, his affection for his daughter as well as for his money, his courtship, and his present to Leah, his wife.

Portia is a favourite, mainly through her discovery of the legal flaw referred to above. We cannot think much of the pretended quarrel with her husband; and the casket scene, which some admire, is, after all, rather far-fetched and affected.

Gratiano and Launcelot Gobbo are the comic characters in the play, the former representing the refined or high-class humour—

"Let me play the fool.
With mirth and laughter let old wrinkles come;
And let my liver rather heat with wine,
Than my heart cool with mortifying groans."

Launcelot is the "low comedian" of the piece. He is an honest fellow, and his dialogue with his father is full of fun.

The beautiful speech beginning, "How sweet the moonlight sleeps upon this bank," is a very graceful conclusion to the play, and shows Shakespeare's knowledge of what is required to make a play perfect in every sense.

Study in detail the third act of *A Midsummer Night's Dream*.

Scene i. line 2. *Pat*=perfect, or quite to the purpose; compare "It will fall pat" (Act v. line 188); also "Now might I do it pat" (*Hamlet*, iii. 3, line 73).

5. *Tiring-house*, dressing-room, retiring-room.

14. *By'r lakin*=by our ladykin, by our little lady, *i.e.* the Virgin Mary. *Parlous*=perilous; *cf.* "Thou art in a parlous state, shepherd" (*As You Like It*, iii. 2, line 46).

25. *Eight and six*. That is, in verses containing eight and six syllables alternately. This is known as the "ballad-metre," and, according to Dr. Johnson, is the easiest metre to write.

81. *Cue*, from the French *queue*, a tail; hence the tail-end of the previous speech, which the player must remember in order to know when to begin his own.

136. *Titania* (*awakening*). Remember that her eyes had been anointed.

154. *Gleek*, scoff, be scornful. See *1 Henry VI.* iii. 2, line 123, "Now where's the Bastard's braves and Charles his gleeks?"

173. *Apricocks*=apricots, *cf.* *Richard II.*, "Bind up yon dangling apricocks."

176. *Waxen thighs*. Bees collect pollen, and carry it home on their legs to make wax.

177. *Glow-worm's eyes*. This is one of the few occasions on which Shakespeare's natural history is at fault. The luminous part of the glow-worm is the tail, not the eyes.

193. *Pease-blossom*. Note that "pease" is singular. Latin, *pisum*. This singular form is used collectively, *e.g.* pease-pudding; compare this with apple-pudding, currant-pudding, in which the singular is also used.

Scene ii. line 90. *Misprision*, mistake.

138. *Eyne*, plural of eye.

237. *Persever*, now spelt and pronounced persevere.

238. *Jole*, another form of *jowl*, the jaw or cheek. Hence "cheek by jole" means faces touching.

356. *Welkin*, sky, clouds.

357. *Acheron*, the river of sorrow, one of the five rivers in the infernal regions.

380. *Harbinger*, forerunner.

English History.

Continue the study of English History to the accession of Henry VII. The period set for this month covers about a century, and teems with civil war. It also includes a war with France, unjust in motive, unwise in purpose, and although marked by some brilliant successes (*e.g.* Agincourt) in its early stages, yet it was followed by reverses quite as humiliating as those which marked the close of the reign of Edward III. The internal history of the country requires careful study on account of the steady growth of the power of Parliament, in spite of the attempts made to render the House of Commons subservient to the Crown, and to narrow the electoral franchise. Both the King of France and the King of Scotland refused to acknowledge Henry IV., and war seemed imminent. Peace with France was maintained by restoring Isabella, the widow of Richard II., to her father, Charles VI., with the greater part of her dowry, and soon after this France was distracted by the quarrels between the Dukes of Orleans and of Burgundy. War with Scotland was avoided by the capture and imprisonment of Prince James. The news of this caused King Robert to die of a broken heart, and the Duke of Albany became Regent. So long as King James was detained in England, Albany was able to exercise regal power in Scotland. Hence Albany was anxious for peace and the retention of King James. During the nineteen years James was a prisoner he was well treated, but that is no excuse for the unjust policy of keeping him from his native dominions. In the west the Welsh, under Owen Glendower, gave great trouble, especially in alliance with the rebellious Percy family.

Henry IV. recognised his indebtedness to the Commons and the Church for his advancement to the throne, and in return he recognised the right of the Commons to direct the appropriation of supplies, and to require an account of State disbursements. He also repeatedly admitted the right of Parliament to interfere with his choice of ministers, and on one occasion, when the Commons had requested the removal of certain persons from the royal household, Henry not only assented, but went on to assure the Commons that he would do the same with

any others about his royal person whom he should find to have incurred the hatred of the people.

In return for the assistance given by the clergy, Henry co-operated with the Church in the endeavour to extirpate the Lollards. The churchmen and statesmen of those days not only believed it to be their duty to stamp out heresy by persecution, but they thought it quite practicable. We know now that persecution strengthens the persecuted sect, or if, by the help of State protection, the Church crushes out all rivalry, it alienates thoughtful people from religion altogether, and becomes corrupt from within. Note the provisions of the statute *de Heretico comburendo*, 2 Hen. IV., c. 15, and the penalties that were inflicted under it.

Nine years after the passing of this law, the Commons petitioned for its mitigation, but Henry stood by the bishops, and replied that the law ought to be made more severe. In 1404 the Commons complained to the King that the clergy did not bear their fair share of the burdens of the State, and in 1407 they calculated what might be done with the money that could be raised if a just tax were imposed on the estates that were held by ecclesiastics; but Henry came to the rescue, and forbade the Commons to discuss the subject.

Henry V. continued his father's policy in religious matters, and in 1414 a still more severe statute was passed against the Lollards. But the clergy were greatly alarmed at the renewal of the proposal that they should contribute towards State expenses, and it was probably in order to shelve that question that they were so strongly in favour of the war with France. Prepare the details of this war—the alleged causes, the reason why the English were successful at first but were defeated in the end. The last battle of this war was the battle of Castillon (July 23, 1453), and within two years of this came the first battle of the Wars of the Roses—St. Alban's (May 23, 1455). This civil war is a very easy one to study.

We have said that the power of Parliament gradually increased, but in 1440 a statute was passed limiting the franchise to freeholders whose land was of the annual value of 40s. at least (*i.e.* about £20 of our money). A further statute was passed, declaring that the only people eligible to serve in Parliament were "*gentlemen born*." This was not enforced, or it would have led to the formation of castes, in which the "gentlemen born" would have been superior to others in the eye of the law. Various underhand means were adopted to interfere with freedom of election, and it is noticeable that in the petition sent in by Cade's followers, "The Complaints of the Commons of Kent," there is the remarkable statement that "the people of the said shire of Kent are not allowed to have their free election in the choosing of the knights of the shire, but letters have been sent from divers estates to the great rulers of the country, the which enforce their tenants and other people by force to choose other persons than the common will is." This petition proves, first, that Henry VI.'s statesmen tried to rule by packed Parliaments; secondly, that the people valued the franchise; and, thirdly, that Cade's followers included men of good social position and of intelligence.

In these days when attempts are being made to revive Protection, it is interesting to note that protective Acts were passed in the reign of Richard III. forbidding the importation of a long list of articles.

Geography.

Finish the physical geography of Europe. The rivers should be studied in fairly close detail. The Volga, though the longest river, is not the most important. Its current is slow, and so it should afford an excellent means of communication, but unfortunately it runs into an inland sea, so that merchandise from other countries than the few round the Caspian is denied access to it. Its length is 2200 miles, and the area of its basin over half a million square miles, so that it drains more than one-eighth of Europe. Although of such small international importance, the Volga later on may play an important part in the development of Russia.

The Danube rises in the Black Forest, and the upper part of its basin is interlocked with the basin of the Rhine. It becomes navigable at Ulm, so that nearly the whole of its 1700 miles of length is serviceable. Magnificent steamers ply on it, and it forms a very important commercial route. The lower part of its course is controlled by an international commission, and is free to the commerce of all nations.

The Rhine is only 760 miles long, but is of very great importance. It rises near Mount St. Gothard, and, joined by several other mountain torrents, it runs past Coire into Lake Constance. Steamers ply on the lake and down the river as far as Schaffhausen. About a mile below this town are the celebrated Falls of the Rhine, one of the most magnificent falls in Europe. The river falls about 60 feet, or, counting the rapids just above, nearly 100 feet, and in the spring and early summer, when the snows are melting in the mountains, the volume of water is immense. The river runs on rapidly past Basle, where it changes its course from west to north, and nearly reaches Mannheim before the stream is slow enough for navigation. Powerful steam-tugs can tow barges up as far as Mannheim, but the passenger steamers go only as far as Mayence (Mainz). From Mayence the river is full of historic interest. To the traveller in the steamer the river seems to run between two closely parallel ranges of hills, but any one who lands and climbs those hills will see that the river really runs through a deep gorge cut in a tableland. The castles and ruins are numerous and picturesque, and have interesting legends connected with them, from the Rat Tower on an island off Bingen, connected with the story of Bishop Hatto, to the Castle of Godesberg, the subject of Thackeray's burlesque. The chief tributaries are the Aare, which drains Central Switzerland, and the Moselle, which runs in at Coblenz (called by the Romans Confluentes, from its situation at the *confluence* of the two rivers). These are on the left bank; on the right are the Neckar, Main, with Frankfort on its banks, Lahn, Ruhr, and Lippe. Opposite Coblenz is the celebrated fortress of Ehrenbreitstein, from the summit of which may be seen the curious spectacle of the muddy Rhine and the clear blue Moselle running in the same channel for a long time without mixing. On entering Holland the Rhine divides into several streams; the northern one, keeping the name of Rhine, or Old Rhine, runs into the North Sea at Katwijk, where there are immense embankments and flood-gates, which keep back the water of the river until the sea outside is at low tide, and which are closed as the tide rises to prevent the sea water from entering and flowing over the land. The main stream is called the Waal, and runs into the same estuary as the Maas, past Rotterdam, into the North Sea. Sometimes the Maas, which, under the name of Meuse, drains parts of northern France and of Belgium, is described as one of the tributaries of the Rhine.

The details of the other rivers will be taken in connection with the countries through which they flow.

Arithmetic.

For this month study chapters xxii. and xxiii. of the *New Arithmetic*, dealing with decimals. Many students find difficulties in this part of the subject simply because they do not recognise the *place value* of the digits as their work proceeds. They should try a few examples in multiplication and division of whole numbers, and read each line of digits in the working, giving the correct place value of each digit. They will then find that the working with decimals involves no new principles.

The following questions were set in the Certificate Examination this year:—

(*a*) *Assuming that if* 3,986,544 *be divided by* 2116 *the quotient is* 1884, *write down* (*without working*) *the quotient*

(i.) *of* 3986·544 ÷ 1884000.

(ii.) *of* ·03986544 ÷ ·001884.

(*b*) *A boy is told to multiply* 3·14159 *by* 4·812; *then to divide the product by* ·151; *then to multiply the quotient by* 9. *In working the sum he misses out all decimal points: how many times the true answer was his answer?*

(*a*) (i.) If 3986544 ÷ 2116 = 1884
then 3986544 ÷ 1884 = 2116.

If we divide a thousandth of 3986544 by 1884 the quotient will be a thousandth of 2116 (*i.e.* 2·116), and if we divide it by a divisor 1000 times as great, the quotient will be only a thousandth of this, namely ·002116.

(ii.) If the dividend is divided by 100,000,000 and the divisor by 1,000,000, the quotient will be divided by 100. Hence the answer to (ii.) is 21·16.

These results can be checked by noticing that in (i.) the divisor is a whole number; and the first step is to divide 3,986,544 *thousandths* by it; the result of this step will therefore be *thousandths*, *i.e.* the quotient begins with ·002. In (ii.) we resolve the divisor mentally into the factors ·000001 and 1884; on dividing by the first factor we obtain 39865·44, and the first step in dividing by the other factor is to divide 3986 *hundreds* by 1884; the result must be a number of *hundreds*. Hence the first digit of the quotient stands in the hundreds place.

(*b*) By neglecting the points every digit of the multiplicand is increased 100,000 fold and every digit of the multiplier 1000 fold. Hence the product is 100,000,000 too great. By dividing

this by a number 1000 times as large as he ought, the error is reduced to a thousandth of what it would have been, that is, it is still 100,000 times too large, and on multiplying by 9 instead of ·9 it is further increased tenfold. *Answer.*—The boy's result was 1,000,000 times the true answer.

ALGEBRA.

Prepare the chapter on factors (ch. x.). Notice the classes to which expressions can be assigned for factorising, and be ready to apply fundamental principles and general formulæ to particular cases.

Great help can be obtained from cyclo-symmetry when it is present, and particularly by using the device of supposing one letter equal to 0 so as to obtain suggestions for possible factors.

GEOMETRY.

Construction of common tangents to two circles. Note that two circles may have four common tangents, unless they cut, when there are two, or touch, when there are three.

Construction of circumscribed, inscribed, and escribed circles of a triangle.

ELEMENTARY SCIENCE.

Matter at rest: Simple devices for gaining mechanical advantage. Matter in Motion: Representation of motion by straight lines. Velocity. Acceleration. Force. The laws of motion. Work. Energy: Conservation of Energy. Gravity: Gravitation, Density, Weight, Specific Gravity. Weight of bodies in air and in water. Water finds its own level.

The following questions were set this year:—

(1) *What is meant by the* mechanical advantage *of a machine? Describe any simple device by means of which you could just support a weight of five pounds, using only a one pound weight.*

The "mechanical advantage" of a machine is the ratio between the force exerted by the machine and the force applied to the machine; thus if a machine will just lift 100 lbs. on the application of a force of 1 lb. the mechanical advantage is 100; if it will raise 5 lbs. on the application of 8, the mechanical advantage is $\frac{5}{8}$ or ·625.

A force of 5 lbs. can be supported by a weight of 1 lb. on a lever of the first order, if the 1 lb. weight be placed on the opposite side of the fulcrum and five times as far from the fulcrum as the weight of 5 lbs.

Since the wheel and the axle may be regarded as a continuous lever, a weight of 5 lbs. attached to a cord passing round the axle will be supported by a weight of 1 lb. fastened to a cord passing in the opposite direction round the wheel if the radius of the wheel is five times that of the axle.

By using two pulley blocks, one fixed and one movable, each containing two wheels, and fastening the end of the cord to the lower, or movable, block, to which also the weight of 5 lbs. is attached, a weight of 1 lb. tied to the free end of the cord will produce equilibrium. In practice the weight of the lower block must be included in the 5 lbs. weight. The 1 lb. weight produces a tension of 1 lb. all through the cord, and since the cord is attached to the lower block five times the total upward pull is 5 lbs.

(2) *How could you determine the specific gravity of an ordinary lead pencil without the use of a balance?*

The specific gravity of sea-water is 1·028 *and of ice* 0·918. *Find what fraction of the volume of an iceberg floats out of water.*

This question illustrates the advantage of reading the whole of an examination paper before beginning to write the answer. Very frequently one question in the paper suggests the answer to another. Here the second question recalls to the student the law of floating bodies, and it suggests naturally enough that this law can be used in answering the first question.

When a body floats partly submerged in water the weight of the body is equal to the weight of water displaced by the submerged portion. Now if we take a narrow jar or tube in which the pencil must float in a vertical position, it is easy to observe and measure the fraction of the pencil that is under water. Suppose that the pencil is not pointed, but cut off squarely at each end, and is 7½ inches long, and that it floats with 1½ inches above the surface of the water, *i.e.* with 6 inches below. Then a cylinder of water of the same diameter as the pencil and 6 inches in length would weigh as much as the 7½ inches of pencil, or if we took equal volumes, the weight of the pencil would be to the weight of the water as 6 : 7½, that is 4 : 5. Hence the specific gravity of the pencil is ⅘ or ·8.

Conversely, in the second question 1·028 c. ft. of ice has the same weight as ·918 of salt water, for each has the same weight as 1 c. ft. of pure water. Hence $\frac{\cdot 918}{1\cdot 028}$ of an iceberg would be below the surface, and $\left(1 - \frac{918}{1028}\right)$ of it would be above, $1 - \frac{918}{1028} = \frac{55}{514}$. The fact that $\frac{918}{1028}$, or roughly $\frac{9}{10}$ of the iceberg must always be under water disposes of the absurd stories of the submerged part melting while the rest remained in the air and fell on passing ships.

THE GEOGRAPHICAL ASSOCIATION.

SOME of our readers may not even have heard of this useful Association, which for the last twelve or thirteen years has been carrying on a very useful work in a quiet and unostentatious way.

The aim of the Association is the improvement of the teaching of geography.

The Association issues every term, at the middle of February, June, and October, *The Geographical Teacher*, a magazine for the discussion of methods of teaching geography, and the diffusion of information useful to teachers. It is sent free to all members of the Association. The Editor is A. J. Herbertson, School of Geography, Oxford. The publishers are Messrs G. Philip and Son, 32 Fleet Street, London, E.C. Members are invited to send to the Editor papers or notes describing their own methods of teaching geography and the views that experience has led them to adopt; also papers dealing with special aspects of the subject, written from the teacher's point of view.

Memorials to Boards of Public Examiners sent in by the Association have already, in many cases, led to a marked improvement in the character of the syllabuses and of the questions set. The committee will be glad to receive suggestions as to further action.

Lectures and meetings for discussion may be arranged at schools or other local centres, and the Assistant Hon. Secretary will be glad to assist in organising such gatherings by supplying information as to lecturers and their terms. Several members of the committee are prepared to give special lectures to teachers on the teaching of geography.

The Assistant Hon. Secretary may be consulted with reference to text-books, atlases, and works of reference useful to teachers. All such inquiries should be accompanied by a stamped addressed envelope, and sent to Mr. J. F. Unstead, Goldsmiths' College, New Cross, London, S.E.

Through the influence of the Society, the Ordnance Survey maps can now be obtained at a cheap rate for teaching purposes, and a collection of lantern slides (maps, diagrams, and views of scenery) has been formed and may be hired.

Further particulars may be obtained from the Hon. Treasurer, Mr. J. L. Masterman, St. Margaret's, Dorking.

PHYSICAL EXERCISE IN THE SARAH TUCKER COLLEGE, PALAMCOTTAH, S. INDIA.

IN the South of India a Second Grade College for Indian Christian girls is busy with its several examinations. The girls vary from the little ones in the kindergarten classes to those studying for the University Examination of the First in Arts. (This corresponds to the Intermediate in Arts at home.) The total number of girls is about 350, and of these some 25 to 30 are students in training as teachers of different grades; these have to undergo the same ordeals as those at home, of a written examination in theory and practical work in blackboard drawing, etc., and giving a lesson. Although our Indian sisters are not naturally fond of physical exercise, yet by having the Government rules behind us they have now got to like it to a certain extent. We are fortunate in being able to have the drilling in the open air; except for the three months of the monsoon there is no fear of being driven in by the rain, and cold is an unknown thing in these parts; we should often be glad of a little of that! As well as drill, our girls also go in for various games, such as skipping and even tennis.

It has, however, required a very great deal of persuasion to bring games to anything like a forward state. The Hindoo girl has an innate fondness for the more sedentary amusements.

OUR SCIENCE SECTION

Subscribers requiring Explanations of Difficulties in any branch of Science, or Advice upon Courses of Study, can obtain all help required by communicating with the Editor, and accompanying their query with the Coupon cut from this number.

NOTES ON PHYSICS.

BY EDWIN EDSER, A.R.C.SC.

Author of "Heat for Advanced Students," "Light for Students," "Differential and Integral Calculus for Beginners," etc.

General Physics.

Moments of Inertia.—It frequently happens that the solution of a problem in Physics or Mechanics involves the determination of the kinetic energy of a moving body. When a body moves without rotation, all of its particles move with the same velocity; consequently its kinetic energy is equal to one half the mass m of the body multiplied by the square of the velocity v common to all its particles. When, however, the body rotates, the various particles of which it is composed move with unequal velocities, and in this case the determination of the kinetic energy of the body is somewhat more complicated. The method used in this case will now be explained.

Angular Velocity.—Let us suppose that a body rotates without being displaced bodily; then a certain line drawn through the body will remain stationary, and the particles of which the body is composed will move in circles around this line; in other words, each particle of the body will remain in an imaginary plane drawn perpendicular to the line just mentioned, and the path of the particle will be a circle in this plane, with centre at the point where the line and plane intersect. The line which remains stationary is called the **axis of rotation** (or merely the axis) of the body. If we now suppose the rotating body to be set in bodily motion, the axis will move with the body; thus the motion of each particle is the resultant of two components, one due to the bodily displacement of the body, and the other due to the angular displacement about the axis of rotation.

If the body is rigid it must retain its shape unaltered during any motion which it experiences. Hence if we choose any two particles of the body, and from these draw straight lines so as to intersect the axis at right angles, these straight lines will permanently retain their relative positions; thus when one of these lines turns through a given angle, the other line must turn through an exactly equal angle. What is true of the two particles mentioned is true of all particles comprised in the body; hence if lines be drawn from all particles comprised in the body, so as to intersect the axis of rotation at right angles, then all of these lines turn through equal angles as the body rotates. The angle through which any one of these lines turns during unit time (one second) is called the **angular velocity** of the body. The angular velocity is measured in *radians per second*, and is generally denoted by the Greek letter ω (omega).

Let a particle of mass m be at a distance r from the axis of rotation; then this particle moves in a circle of radius r, and in one second the line drawn from the particle to the axis turns through an angle ω. (If the body rotates at the rate of n turns per second, then $\omega = 2\pi n$.) The distance v_1, through which the particle moves in a second, is called the **linear velocity** (or merely the velocity) of the particle; this is equal to the circular arc which it describes in a second, that is, to ωr_1.

The kinetic energy of a particle is equal to half the mass of the particle multiplied by the square of its linear velocity; hence the kinetic energy of the particle we are considering is equal to

$$\frac{1}{2}m_1v_1^2 = \frac{1}{2}m_1(r_1\omega)^2 = \frac{1}{2}m_1r_1^2 \cdot \omega^2.$$

Now although the various particles of the body are moving with different linear velocities, they all possess one common angular velocity ω. The kinetic energy of the body as a whole is equal to the sum of the kinetic energies of its particles; hence if we consider the body to be composed of particles of masses $m_1, m_2, m_3, \ldots$ at distances $r_1, r_2, r_3, \ldots$ from the axis of rotation, then the kinetic energy of the body as a whole will be equal to

$$\frac{1}{2}(m_1r_1^2 + m_2r_2^2 + m_3r_3^2 + \ldots)\,\omega^2.$$

For a given body rotating about a given axis, the series of terms enclosed by the brackets will have a constant value, which is called the **moment of inertia** of the body about the given axis: this may be conveniently denoted by I. Thus the kinetic energy of the body when it rotates with an angular velocity ω about the given axis is equal to

$$\frac{1}{2}\,\mathrm{I}\,\omega^2.$$

The moment of inertia of a body about a given axis is thus not a physical property of the body, but a magnitude obtained by supposing the body to be divided into its constituent particles, multiplying the mass of each particle by the square of its distance from the axis of rotation (often abbreviated to *the axis*) of the body, and then evaluating the sum of the terms so obtained. Since each term in the sum has the dimensions of a mass multiplied by the square of a distance, the dimensions of a moment of inertia are those of a mass multiplied by the square of a distance. In the *c.g.s.* system of units, a moment of inertia will be expressed in terms of the gram-centimetre-squared, or gr. (cm.)^2. In the British system a moment of inertia will be expressed in terms of the pound-foot squared, or lb. (ft.)^2. From what has already been said it is obvious that the value of the moment of inertia of a body will depend on the position of the axis chosen.

Exercises.—(1) Two small metal spheres, each of mass 10 grms., are fastened at the ends of a rod of negligible mass, the distance between the centres of the spheres being 20 cms. Find the moment of inertia of this combination about an axis through the mid point of the rod, at right angles to its length.

Ans. 2,000 grm. (cm.)^2.

(2) A thin circular metal ring has a mass of 100 grms., and the diameter of the ring is 20 cms. Find the moment of inertia of the ring about an axis through the centre and at right angles to the plane of the ring. Ans. 10,000 grm. (cm.)^2.

(Note that in this instance the whole of the mass is at a distance of 10 cms. from the axis.)

A formula for the value of the moment of inertia of a body of known mass, about a given axis, can generally be obtained when the body has a simple geometrical shape; this can be done most expeditiously by the aid of the Integral Calculus (see *Diff. and Int. Calc. for Beginners*, pp. 152–158), but those unacquainted with this important branch of mathematics may find the following algebraical methods useful.

Moment of inertia of a thin straight rod, with respect to an axis through its mid point and perpendicular to the length of the rod.

Let BC (Fig. 1) be the rod, and A its mid point. Let l be the length of the rod from end to end, while M is the total mass, and m the mass per unit length of rod. Then $M = ml$.

Let DE be a small element of the rod, where $AD = x_a$, and $AE = x_b$. The length of the element $= (x_b - x_a)$, and its mass $= m(x_b - x_a)$.

If all parts of the element DE were at a uniform distance from the axis through A, we could find that part of the moment of inertia due to the element by multiplying its mass by

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the square of its distance from A. Since, however, the end E of the element is farther than D from A, we must multiply the mass of the element by the *mean value of the square of the distances* of its constituent particles from A. Let us suppose that DE is small, but not infinitely small. If the whole of the mass

FIG. 1.

were at E, the square of its distance from A would be x_b^2; if it were at D, the square of its distance from A would be x_a^2; if it were at some intermediate point, the square of its distance from A would not differ much from $(x_a x_b)$, which is greater than x_a^2 and less than x_b^2. Hence the average value of the square of the distances from A, of all points between D and E, can be taken as

$$\frac{x_b^2 + x_a x_b + x_a^2}{3}$$

Thus that part of the moment of inertia due to DE is equal to

$$m(x_b - x_a) \cdot \frac{x_b^2 + x_a x_b + x_a^2}{3} = m \cdot \frac{x_b^3 - x_a^3}{3} \quad . \quad . \quad . \quad (1)$$

Now let us suppose that AC is divided up into short elements by points at distances $x_0, x_1, x_2, x_3 \ldots x_n$ from A, where x_0 is equal to zero, and the terms increase regularly up to x_n, which is equal to AC or $(l/2)$. Then we can write down the values of the parts of the total moment of inertia which are due to the various short elements, and add these together, when we shall obtain the part of the moment of inertia due to the half AC of the rod. The part of the moment of inertia due to the element between distances x_1 and x_0 will be found by writing x_1^3 in place of x_b^3, and x_0^3 in place of x_a^3, in (1), and similarly with the other elements. Writing the various results under each other, we obtain

$$\frac{m}{3}(x_1^3 - x_0^3)$$

$$\frac{m}{3}(x_2^3 - x_1^3)$$

$$\frac{m}{3}(x_3^3 - x_2^3)$$

. . .

. . .

$$\frac{m}{3}(x_{n-1}^3 - x_{n-2}^3)$$

$$\frac{m}{3}(x_n^3 - x_{n-1}^3)$$

On adding these quantities together, the positive value of x_1^3 is just cancelled by a negative value of the same quantity, and similarly with all quantities except x_0^3 and x_n^3. Thus that part of the moment of inertia due to the part AC of the rod is equal to

$$\frac{m}{3}(x_n^3 - x_0^3),$$

and the moment of inertia of the whole rod is twice as great. Further, x_0 is equal to zero. Hence the moment of inertia of the rod BC about an axis through A and perpendicular to BC is equal to

$$\frac{2mx_n^3}{3} = \frac{2m}{3} \cdot \left(\frac{l}{2}\right)^3 = \frac{ml^2}{12}.$$

It is generally more convenient to express this result in terms of the total mass M of the rod, rather than in terms of m, the mass per unit length of the rod. This is easily done, for

$$\frac{ml^2}{12} = \frac{(ml)l^2}{12} = \frac{Ml^2}{12}.$$

In obtaining this result we have assumed that the rod is thin, so that all points of it lie practically in the plane of the paper in Fig. 1. If we suppose the dimensions, in the plane of the paper and perpendicular to BC, to increase (so that we obtain a flat rectangular sheet), the same result will apply, l now being the length of the strip perpendicular to the axis. But if the dimensions increase in a direction perpendicular to the plane of the paper, the results obtained will no longer hold.

Moment of Inertia of a circular disc about an axis through its centre and perpendicular to its plane.

Let the total mass of the disc be M, while r is its radius, and its mass per unit area is m. Then

$$M = \pi r^2 m.$$

Divide the disc into circular strips by means of circles of radii $r_0, r_1, r_2, \ldots r_n$, where $r_0 = 0$, and the terms regularly increase to $r_n = r$, the radius of the disc. The mass of the strip between (say) the circles of radii r_2 and r_3 is $\pi(r_3^2 - r_2^2)m$, and we may write down the average value of the square of the distance of this mass from the centre as $(r_3^2 + r_2^2)/2$. Hence the part of moment of inertia due to this circular strip

$$= \frac{m\pi(r_3^2 - r_2^2)(r_3^2 + r_2^2)}{2} = \frac{m\pi(r_3^4 - r_2^4)}{2} \quad . \quad . \quad . \quad . \quad (2)$$

The thoughtful student may well inquire why we write the average value of the square of the distance from the centre as $(r_3^2 + r_2^2)/2$, while if we followed the procedure formerly used in connection with the rod we should write $(r_3^2 + r_3 r_2 + r_2^2)/3$ for this quantity. The fact is that either of these expressions gives an approximation to the value of the average, which becomes more exact as r_3 and r_2 are made more nearly equal. Now we may obviously suppose r_3 and r_2 to be as nearly equal as we like, since any approach to equality can be obtained by dividing the disc into a large enough number of circular strips; thus, from the point of view of obtaining a correct average value of the square of the distance from the centre, either of these methods is as good as the other. In choosing between them, therefore, we need consider only the possibility of using the result obtained in the method of summation which must subsequently be employed. Now this method of summation depends for its success on each term being the difference between two quantities, each of which is cancelled by another quantity of equal magnitude but opposite sign in a preceding or succeeding term; and it is clear that the result could not be obtained if we wrote, instead of (2),

$$\frac{m\pi(r_3^3 - r_2^3)(r_3^2 + r_3 r_2 + r_2)^2}{3} = m\pi\frac{r_3^4 - r_3 r_2^3 + r_3 r_2^3 - r_2^4}{3}$$

From a consideration of (2) we can now write down the elements of the total moment of inertia due to the various strips, the smallest lying between the circles of the radii r_0 and r_1, and the largest lying between the circles of radii r_{n-1} and r_n; we thus obtain the following results:—

$$\frac{m\pi}{2}(r_1^4 - r_0^4)$$

$$\frac{m\pi}{2}(r_2^4 - r_1^4)$$

$$\frac{m\pi}{2}(r_3^4 - r_2^4)$$

. . . . .

. . . . .

$$\frac{m\pi}{2}(r_{n-1}^4 - r_{n-2}^4)$$

$$\frac{m\pi}{2}(r_n^4 - r_{n-1}^4).$$

Adding these together, and remembering that $r_0 = 0$, and $r_n = r$, the radius of the disc, we obtain for the total moment of inertia of the disc

$$\frac{m\pi}{2}r_n^4 = \frac{m\pi r^4}{2} = \frac{m\pi r^2 \cdot r^2}{2} = \frac{Mr^2}{2}.$$

This result also gives the moment of inertia of a circular cylinder about its geometrical axis, if M is the mass of the cylinder and r is the radius of its circular section. For suppose the cylinder to be cut into a large number n of thin circular discs, all being exactly similar; the mass of one of these discs is M/n, and the moment of inertia of this disc about an axis through its centre and perpendicular to its plane is

$$\frac{M}{n} \cdot \frac{r^2}{2}.$$

Each disc adds as much to the total moment of inertia of the cylinder as any other, since all are similarly situated with respect to the axis; thus the total moment of inertia of the cylinder is n times as great as that of each of the discs, *i.e.* is equal to $Mr^2/2$.

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Moment of inertia of a thin circular ring about a diameter as axis.

Let ABC (Fig. 2) represent the circular ring, and AC the

FIG. 2.

diameter which is to serve as the axis for the moment of inertia. Let the ring be divided into four quadrants by the diameter AC and another diameter perpendicular to this; and let each quadrant be divided into any even number $2n$ of equal elements, one of these being at B. From B draw BD perpendicular to AC; then if m is the mass of each of the equal elements of the ring, the element at B will contribute to the total moment of inertia a part equal to $m.(BD)^2$. Let E be the centre, and $EB = r$ be the radius of the ring. Then if the angle $BEA = \theta$, it follows that

$$BD = BE \sin\theta = r \sin\theta,$$

and the part of the moment of inertia due to the element at B is

$$mr^2 \sin^2\theta.$$

Now the elements lying in one quadrant of the ring starting from A, will be $2n$ in number, and for half of these θ will lie between 0 and $\pi/4$, and for the other half θ will lie between $\pi/4$ and $\pi/2$. The elements in a quadrant may therefore be grouped in pairs, an element with a value of $\theta = \theta_1$ being grouped with another having a value of $\theta = \{(\pi/2) - \theta_1\}$. That part of the moment of inertia due to this pair of elements is equal to

$$mr^2 \sin^2\theta_1 + mr^2 \sin^2\left(\frac{\pi}{2} - \theta_1\right)$$

$$= mr^2 (\sin^2\theta_1 + \cos^2\theta_1) = mr^2,$$

which is independent of θ, so that each pair of elements contributes the same amount to the total moment of inertia. There are n pairs of elements in a quadrant, so that the part of the moment of inertia due to one quadrant is equal to nmr^2; and since each quadrant obviously contributes to the total moment of inertia as much as any other quadrant, the total moment of inertia will be equal to $4nmr^2$. There are $8n$ elements in the entire ring, so that if M is the mass of the ring, $M = 8nm$. Thus the moment of inertia of the ring is equal to

$$4nmr^2 = \frac{8nm}{2} \cdot r^2 = \frac{M}{2} r^2,$$

or half the mass multiplied by the square of the radius of the ring.

The moment of inertia of a ring about an axis through its centre and **perpendicular** to its plane is equal to Mr^2 (all elements in this case being at a uniform distance r from the axis); thus it follows that *the moment of inertia of a ring about a diameter is equal to half the value of the moment of inertia of the same ring about an axis through its centre and perpendicular to its plane.*

Moment of Inertia of a Circular Disc about a Diameter.—Divide the disc into a number of strips by means of circles, in the manner described previously; then the moment of inertia of each of these strips about a diameter will be equal to half the value of its moment of inertia about an axis through its centre and perpendicular to its plane; so that the total moment of inertia of the disc about a diameter will be equal to half the value of the moment of inertia of the same disc about an axis through its centre and perpendicular to its plane. This last quantity has already been proved to be equal to $Mr^2/2$, and therefore the moment of inertia of a disc about a diameter is equal to $Mr^2/4$. It must be noticed that the moment of inertia of a circular cylinder (which may be considered to be a thick disc) about an axis through its mid point and perpendicular to its length will not be equal to $Mr^2/4$, for the various discs into which the cylinder may be divided are not symmetrically situated with respect to the axis.

Exercise.—(3) Find the moment of inertia of a thin annular strip bounded by two concentric circles of radii R and r, the mass of the strip being M: (*a*) when the axis is a diameter, and (*b*) when the axis passes through the common centre of the circles, and is perpendicular to their plane.

Answers: (*a*) $\frac{M(r^2+R^2)}{4}$; (*b*) $\frac{M(r^2+R^2)}{2}$.

Determinations of some other typical moments of inertia will be explained in next month's *Practical Teacher*.

Electricity and Magnetism.

Explain how telephone currents may be measured experimentally. What function of the current is it that is directly determined? *University of London, B.Sc. Final*, 1904.

The characteristic of telephone currents is that they alternate with a very great frequency (that produced by singing C into a telephone alternates 256 times per second), and also these currents are of very small magnitude. Mr. Duddell has succeeded in exhibiting the fluctuations of telephone currents by the aid of his oscillograph (see *Practical Teacher*, September 1906, pp. 159–160), but the best method of measuring such currents is by means of another arrangement, also due to Mr. Duddell. In this arrangement the telephone current is sent through a narrow strip of gold leaf, which consequently becomes heated. The rise of temperature is extremely small, so small that it could not be detected by ordinary methods; but if the piece of gold leaf is placed near the thermo-junction of a Boys's radio-micrometer a distinct deflection is produced. For a description of Boys's radio-micrometer the student is referred to *Heat for Advanced Students*, by the author (p. 410). Fig. 3 is a diagram-

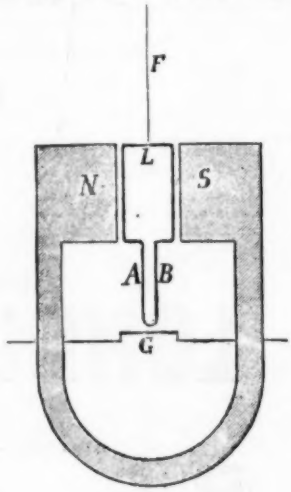

FIG. 3.

matic representation of Duddell's micro-ammeter (as it is called). L is a small loop of thin wire, suspended by means of a quartz fibre F between the poles N and S of a powerful magnet. The ends of the loop are joined below to two vertical strips, one A of antimony and the other B of bismuth; these strips are connected at their lower ends by means of a small piece of blackened copper foil. The alternating current to be measured is sent through a strip of gold leaf G placed immediately beneath the thermo-junction, which thus receives heat partly by radiation and partly by convection from the heated gold leaf G. A steady deflection is thus produced, which is proportional to the average rate at which heat is dissipated in the gold leaf; as the heating effect of a current is proportional to the square of the current, it follows that the deflection of the instrument is proportional to the average value of the square of the current (the mean square current) which traverses the gold foil. The constant of the instrument can be determined by sending a small continuous current of known value through the strip of gold leaf.

Using the instrument described above, Mr. Duddell has succeeded in measuring alternating currents of which the square root of the mean square value (root-mean-square or R.M.S.) did not exceed 0·0001 ampere. By the same means Mr. Duddell has also succeeded in measuring the oscillatory currents induced in wireless telegraphy antennæ.

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MATHEMATICS.

(STAGES 2 AND 3.)

BY FRANK CASTLE, M.I.M.E.,

Royal College of Science; Lecturer on Mathematics, etc., Morley College; Author of "Elementary Practical Physics," "Practical Mathematics," etc.

Ex. 5. (a) If $a+\sqrt{c}=b+\sqrt{d}$, where a and b are rational and $\sqrt{c}$ and $\sqrt{d}$ are irrational, show that $a=b$ and $c=d$.

(b) Reduce the following expression to the form $a+\sqrt{b}$.

$$\frac{44}{3-\sqrt{5}}+\frac{44}{3+2\sqrt{5}}. \qquad (1895)$$

(c) Multiplying each fraction by the complementary surd we obtain

$$\frac{44(3+\sqrt{5})}{9-5}+\frac{44(3-2\sqrt{5})}{9-4\times5}$$

$$=11(3+\sqrt{5})-4(3-2\sqrt{5})$$

$$=33+11\sqrt{5}-12+8\sqrt{5}=21+19\sqrt{5}.$$

Ex. 6. If $x=\sqrt{3}+\sqrt{5}$, find in its simplest surd form, with a rational denominator, the value of $\dfrac{x}{1+x+x^2}$.

Substituting the given value for x

then $$\frac{x}{1+x+x^2}=\frac{\sqrt{3}+\sqrt{5}}{9+\sqrt{3}+\sqrt{5}+2\sqrt{15}}$$

or $$\frac{(\sqrt{3}+\sqrt{5})\{9+\sqrt{3}-\sqrt{5}(1+2\sqrt{3})\}}{84+18\sqrt{3}-5(13+4\sqrt{3})}$$

$$=\frac{(\sqrt{3}+\sqrt{5})\{9+\sqrt{3}-\sqrt{5}(1+2\sqrt{3})\}}{19-2\sqrt{3}}$$

$$=\frac{[(\sqrt{3}+\sqrt{5})\{9+\sqrt{3}-\sqrt{5}(1+2\sqrt{3})\}](19+2\sqrt{3})}{349}$$

$$=\frac{57\sqrt{5}-23\sqrt{3}+6\sqrt{15}-44}{349}$$

Ex. 7. (a) If x and y are rational quantities, and $\sqrt{a}$ and $\sqrt{b}$ quadratic surds, show that if $(x+\sqrt{a})^3=y+\sqrt{b}$ then $(x-\sqrt{a})^3=y-\sqrt{b}$.

(b) Find the square root of $174-36\sqrt{6}$. (1904)

Ans. $\pm9\sqrt{2}-2\sqrt{3}$.

Ex. 8. Find to five places of decimals the value of

$$\frac{3-\sqrt{5}}{(\sqrt{3}+\sqrt{5})^3}+\frac{3+\sqrt{5}}{(\sqrt{3}-\sqrt{5})^3}$$

having given $\sqrt{3}=1{\cdot}73205$. (1898)

Ans. 17.

Ex. 9. (a) Rationalise the denominators of $\dfrac{4\sqrt{2}}{\sqrt{3}-1}$ and $\dfrac{2\sqrt{2}}{\sqrt{3}+2}$, and find their sum.

(b) Find the product of $\dfrac{\sqrt{3}}{1+\sqrt{3}}$ and $\dfrac{\sqrt{2}}{2-\sqrt{3}}$ in a form in which the denominator is rational.

Ans. (a) $6\sqrt{2}$; (b) $\dfrac{\sqrt{6}+3\sqrt{2}}{2}$. (1898)

Ex. 10. (a) If $a+\sqrt{b}$ have a square root of the form $\sqrt{p}+\sqrt{q}$, where p and q are rational, show that a^2-b is a perfect square, and that it is the square of $p-q$.

(b) Simplify $\sqrt{(7+3\sqrt{5})}$.

(c) $\sqrt{(15-4\sqrt{14})}+\dfrac{1}{\sqrt{(15-4\sqrt{14})}}$. (1901)

Ans. $\dfrac{3\sqrt{2}+\sqrt{10}}{2}$; $4\sqrt{2}$.

Ex. 11. (a) If $x(\sqrt{3}+2)=\sqrt{3}-1$, find in its simplest form the value of $\dfrac{1}{1-x}-\dfrac{1}{1+x}$.

(b) Extract the square root of $\dfrac{17}{6}-2\sqrt{2}$. (1902)

Ans. (a) $\dfrac{10+2\sqrt{3}}{33}$; (b) $\dfrac{3\sqrt{6}-4\sqrt{3}}{6}$.

Ex. 12. Reduce

$$\frac{7-\sqrt{7}}{(5+\sqrt{7})(\sqrt{7}-2)}$$

to its simplest form, with a rational denominator, and calculate its value as a decimal, having given $\sqrt{7}=2{\cdot}646$. (1903)

Ans. $\dfrac{6\sqrt{7}}{18}$, 0·882.

Equations.—The various forms of equations, simple and quadratic, in one or more unknowns, present so many difficulties, that it is probably impossible to give any general rules which may be applied with advantage to all cases. Perhaps the best course to adopt is to become familiar with a few of the usual methods adopted, and in addition to obtain as much practice as possible in the solution of given equations.

Suitable exercises may be obtained from any text-book on algebra. In addition to this, practice in typical questions is desirable; these may be obtained from previous questions set in the Board of Education and other examinations.

Simple Equations with one or more Unknowns.—It may be assumed that the reader is familiar with the easier methods of solving a simple equation, involving the process of simplifying a given fractional equation or elimination in simple or linear equations of two or more unknowns.

But these more general methods are not always applicable, and it is necessary to suggest other processes, such as by factors, etc., which may often be used with advantage.

The following will probably be found useful for the purpose named:—

Ex. 1. Find the value of

$$\left(x+\frac{a}{b}\right)\left(x+\frac{b}{a}\right)-\left(x-\frac{a}{b}\right)\left(x-\frac{b}{a}\right),$$

$$\text{when } x=\frac{1}{a^2+b^2}.$$

The given expression becomes

$$\left(\frac{bx+a}{b}\right)\left(\frac{ax+b}{a}\right)-\left(\frac{bx-a}{b}\right)\left(\frac{ax-b}{a}\right)$$

$$=\frac{abx^2+a^2x+b^2x+ab-(abx^2-a^2x-b^2x+ab)}{ab}$$

$$=\frac{2x(a^2+b^2)}{ab}.$$

Substituting the given value for x, this becomes

$$\frac{2(a^2+b^2)}{ab(a^2+b^2)}=\frac{2}{ab}.$$

Quadratic Equations.—In considering the square of a binomial expression such as $(x+a)^2=x^2+2ax+a^2$ it will be noticed that when the expression on the right-hand side of the equation is a complete square, then the third term (a^2) is the square of one-half the coefficient of x; hence to solve a given quadratic equation we may arrange all the terms in the unknown quantity on the left-hand side of the equation, the coefficient of x^2 being unity, then add the square of one-half the coefficient of x to both sides of the equation.

Ex. 2. Solve the equation

$$x^2-7x+12=0.$$

$$\therefore x^2-7x+\left(\frac{7}{2}\right)^2=-12+\frac{49}{4}=\frac{1}{4};$$

$$\therefore x=\frac{7}{2}\pm\frac{1}{2}=3 \text{ or } 4.$$

Another method of frequent application is to arrange where possible the given expression in the form of two factors.

Thus $x^2-7x+12=(x-3)(x-4)=0$.

Hence either $x-3=0$; $\therefore x=3$,

or $x-4=0$; $\therefore x=4$.

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The method just referred to, in a more general form may be indicated as follows :—

Ex. 3. Solve the equation

$$ax^2+bx+c=0.$$

$$\therefore x^2-\frac{b}{a}x=-\frac{c}{a},$$

$$\text{or } x^2-\frac{b}{a}x+\left(\frac{b}{2a}\right)^2=-\frac{c}{a}+\frac{b^2}{4a^2}=\frac{b^2-4ac}{4a^2};$$

$$\therefore x=\frac{b}{2a}\pm\frac{\sqrt{b^2-4ac}}{2a},$$

Hence the roots are

$$\frac{b}{2a}+\frac{\sqrt{(b^2-4ac)}}{2a},$$

$$\text{and } \frac{b}{2}-\frac{\sqrt{(b^2-4ac)}}{2a}.$$

If α and β denote the roots of the given equation, then we find

$$\text{sum of roots or } \alpha+\beta=\frac{2b}{2a}=\frac{b}{a}$$

$$\text{product of roots or } \alpha\beta=\frac{b^2}{4a^2}-\frac{(b^2-4ac)}{4a^2}=\frac{c}{a}.$$

Ex. 4. (*a*) If α and β are the roots of the equation

$$ax^2+bx+c=0,$$

show that $\alpha+\beta=-\frac{b}{a}$ and $\alpha\beta=\frac{c}{a}$.

(*b*) Form in terms of a, b, c the quadratic whose roots are

$$\frac{1-\alpha}{1+\alpha} \text{ and } \frac{1-\beta}{1+\beta}. \qquad (1901)$$

(*a*) $ax^2+bx+c=0,$

$$\text{or } x^2+\frac{b}{a}x+\left(\frac{b}{2a}\right)^2=-\frac{c}{a}+\frac{b^2}{4a^2}=\frac{b^2-4ac}{4a^2};$$

$$\therefore x=-\frac{b}{2a}\pm\frac{\sqrt{(b^2-4ac)}}{2a},$$

Hence the roots are $-\frac{b}{2a}+\frac{\sqrt{(b^2-4ac)}}{2a}$,

$$\text{or } -\frac{b}{2a}-\frac{\sqrt{(b^2-4ac)}}{2a}.$$

The sum of the roots is $-\frac{b}{a}$.

The product of the roots is $\frac{b^2}{4a^2}-\frac{b^2-4ac}{4a^2}$

$$=\frac{c}{a}.$$

Hence $\alpha+\beta=-\frac{b}{a}$,

and $\alpha\beta=\frac{c}{a}$.

Sum of the roots $=\frac{1-\alpha}{1+\alpha}+\frac{1-\beta}{1+\beta}$

$$=\frac{1-\alpha+\beta-\alpha\beta+1+\alpha-\beta-\alpha\beta}{(1+\alpha)(1+\beta)}$$

$$=\frac{2-2\alpha\beta}{1+\alpha+\beta+\alpha\beta}=\frac{2(a-c)}{a-b+c}.$$

Product of roots is $\frac{1-\alpha}{1+\alpha}\times\frac{1-\beta}{1+\beta}$

$$=\frac{1-\alpha-\beta+\alpha\beta}{1+\alpha+\beta+\alpha\beta}$$

$$=\frac{1+\frac{b}{a}+\frac{c}{a}}{1-\frac{b}{a}+\frac{c}{a}}=\frac{a+b+c}{a-b+c}.$$

Hence the required quadratic equation is

$$x^2-\frac{2(a-c)x}{a-b+c}+\frac{a+b+c}{a-b+c}=0;$$

$$\therefore (a-b+c)x^2-2(a-c)x+a+b+c=0.$$

Ex. 5. Solve the following equations :—

(*a*) $3x+4\sqrt{(169-x^2)}=56.$

(*b*) $\frac{(x+a)^2+(x-b)^2}{(x+a)^2-(x-b)^2}=\frac{a^2+b^2}{2ab}.$

(*c*) $\frac{x-1}{x+1}=\frac{2y}{9}, \quad \frac{y-1}{y+1}=\frac{x}{10}.$ (1906)

(*a*) $3x+4\sqrt{(169-x^2)}=56,$

or $3x-56=4\sqrt{(169-x^2)}$;

$\therefore 9x^2-336x+3136=2704-16x^2,$

or $25x^2-336x=-432.$

$$x^2-\frac{336}{25}x+\left(\frac{168}{25}\right)^2=-\frac{432}{25}+\frac{28224}{625}=\frac{17424}{625};$$

$$\therefore x=\frac{168}{25}\pm\frac{132}{25}$$

$$=12 \text{ or } -\frac{36}{25}.$$

(*b*) $\frac{(x+a)^2+(x-b)^2}{(x+a)^2-(x-b)^2}=\frac{a^2+b^2}{2ab},$

Adding denominators to numerators,

$$\frac{2(x+a)^2}{(x+a)^2-(x-b)^2}=\frac{(a+b)^2}{2ab},$$

$$\text{or } \frac{2(x+a)^2}{2(x-b)^2}=\frac{(a+b)^2}{(a-b)^2};$$

$$\therefore \frac{x+a}{x-b}=\frac{a+b}{a-b},$$

$$\text{or } (x+a)(a-b)=(x-b)(a+b),$$

$$ax+a^2-bx-ab=ax+bx-ab-b^2;$$

$$\therefore x=\frac{a^2+b^2}{2b}.$$

(*c*) $\frac{x-1}{x+1}=\frac{2y}{9}$ . . . (i.) $\frac{y-1}{y+1}=\frac{x}{10}$ . . . . (ii.)

From (i.) $9x-9=2xy+2y$ . . . . . (iii.)

„ (ii.) $10y-10=xy+x$ . . . . . (iv.)

or $20y-20=2xy+2x.$

Subtracting $11x-22y+11=0,$

or $x-2y+1=0;$

$\therefore x=2y-1.$

Substitute this value in (iv.)

$\therefore 10y-10=y(2y-1)+2y-1,$

or $10y-10=2y^2+y-1;$

$\therefore 2y^2-9y+9=0,$

or $(2y-3)(y-3)=0.$

Hence either $2y-3=0$ or $y-3=0;$

$\therefore y=\frac{3}{2}$ or 3.

Substituting this value in (ii.)

$\therefore \frac{2}{4}=\frac{x}{10};$ $\therefore x=5.$

$\frac{\frac{1}{2}}{5}=\frac{x}{10};$ $\therefore x=2.$

$\frac{1}{2}$

Hence the required values are $x=2, 5$, $y=3$ or $\frac{3}{2}$.

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Many substances with large dielectric constants (water, methyl and ethyl alcohols, formic acid) consist mainly of polymerised molecules, and are therefore bad conductors.

Others, with large dielectric constants and small polymerisation, are unsuitably constituted; nitro-benzene, ethyl nitrate, and benzonitrile, for example, contain the groups NO_2, NO_3, and CN, which readily form ions, but on the other hand they contain the groups C_6H_5 and C_7H_7, which have never been observed in the form of ions.

Fused salts, in all probability, possess high dielectric constants; their chemical constitution is very favourable to the formation of ions; nothing is known of their association factor. They form the only group of pure substances with any considerable electrolytic conductivity.

In the case of solutions, it is extremely probable that the capacity of the ions to unite with molecules of the solvent has an important influence on the degree of dissociation. Solutions in water and liquid anhydrous ammonia are mentioned as illustrations of this.

Sulphur Dioxide as a Solvent.—Liquid sulphur dioxide has a remarkable power of dissolving the most varied substances, both inorganic and organic, the solutions often showing a characteristic colour; thus potassium, sodium, and ammonium iodides all dissolve readily, forming yellow solutions. Among soluble organic substances are benzene, naphthalene, ethyl alcohol, benzoic acid, phenol, ethyl acetate, aniline, diphenylamine, α- and β-naphthylamine. The solutions of diphenylamine and α-naphthylamine are blood-red in colour, that of β-naphthylamine is orange.

The fact that the dissolved substances react readily with each other points to their being electrolytically dissociated: thus by double decomposition $KI + NH(CH_3)_3Cl = KCl + NH(CH_3)_3I$; all these substances are soluble in liquid sulphur dioxide except potassium chloride, which is accordingly precipitated. Ammonium thiocyanate and sublimed ferric chloride give a blood-red colour, exactly as in aqueous solution.

The conductivity of sulphur dioxide solutions is considerable, and in some cases greater than that of equally concentrated aqueous solutions. The increase of the molecular conductivity with dilution is irregular, and for the iodides much more marked than in their aqueous solutions. Ammonium salts in sulphur dioxide solution have a smaller conductivity than potassium or rubidium salt solutions of equal concentration; the conductivity of ammonium, tetramethylammonium, and tetraethylammonium iodides increases with the complexity of the positive ion. The difference between μ_{32} and μ_{16} for potassium iodide is greater in sulphur dioxide solution than in aqueous solution; hence both the degree of dissociation and the ionic velocities differ in the two solvents.

As a further test of the degree of dissociation, determinations of the molecular weight have been carried out. The boiling-point of sulphur dioxide was calculated to be 15°, and with this constant the method gave normal and steady values for the molecular weights of naphthalene, toluene, and acetanilide. The iodides of potassium, sodium, rubidium, and ammonium give a value for the molecular weight which is nearly twice the normal value, whilst certain other salts, such as potassium thiocyanate and tetramethylammonium iodide, have approximately the theoretical molecular weight, thus behaving like non-electrolytes.

Specific Heats at Low Temperatures.—U. Behn has determined the specific heats of a large number of metals and a few alloys at low temperatures. Small cylinders of aluminium, iron, nickel, copper, lead, palladium, iridium, and platinum, contained in test tubes, were cooled in a bath of liquid air or a mixture of solid carbon dioxide and alcohol; they were then introduced into a quantity of water in a calorimeter, and the specific heat calculated in the usual way. In all cases examined the specific heat diminishes as the temperature falls, the decrease being greatest for the metals with large specific heat.

The mean atomic heats of copper, nickel, iron, and aluminium, in the interval −79° to −186°, lie between the values 4·0 and 4·5.

The specific heats of antimony, tin, cadmium, silver, zinc, magnesium, and graphite have been determined by the same method.

In these, as in the earlier cases, the specific heat diminishes with falling temperature; the smaller the atomic weight of the metal, and the lower the temperature reached, the greater is the decrease of the specific heat. The mean atomic heat of graphite for the interval −79° to −186° is only 0·9.

From the mean specific heats obtained by experiment, the true specific heat c at any particular temperature t may be calculated, with the help of the relation $c = A + Bt + Ct^2$, where A, B, and C are constants. The atomic heat of graphite at −186° is thus calculated to be 0·486. Of the curves showing the relation between true specific heat and temperature, those for lead, antimony, tin, and graphite are nearly straight lines.

The variation of specific heat with temperature is seen from these curves to be greatest in the case of elements with a small atomic weight and a small atomic volume.

For brass and a few alloys of lead and tin, the specific heat has approximately the same value as that calculated from the specific heats of the component metals.

A Lecture Experiment.—A case of chemical equilibrium suitable for demonstration is the following: Benzene-sulphon-camphylamide is suspended in an excess of 10 per cent. sodium hydroxide solution, and, in the course of half a minute, is converted almost completely into the insoluble sodium salt; on adding ether, almost the whole of the sulphonamide is regenerated. In this way it is easy to demonstrate the fact that in the equation

$$HA + NaOH \rightleftarrows NaA + HOH,$$

the equilibrium passes over almost completely to the right or to the left, when the sodium salt or the acid is removed from the liquid phase in which interaction takes place. Benzene-sulphon-camphenamide can also be used with a 6–7 per cent. solution of sodium hydroxide.

Volumetric Composition of Hydrogen Fluoride.—Henri Moissan has determined the volumetric composition of hydrogen fluoride (1) by electrolysing aqueous hydrogen fluoride, collecting and measuring the liberated hydrogen, and the oxygen formed by the fluorine acting on the water; and (2) by allowing a measured volume of fluorine to act on water, the liberated oxygen being measured, and the quantity of hydrofluoric acid formed being estimated by titration. In all cases, the ozone in the oxygen was either decomposed by heating or estimated by titration. The results show that hydrogen fluoride is formed by the union of equal volumes of hydrogen and fluorine.

Manganese Perfluoride.—The following is a summary of a description of manganese perfluoride prepared by Henri Moissan:—

Metallic manganese is attacked by fluorine at the ordinary temperature, but the reaction is limited by the formation of a layer of fluoride on the surface of the metal. If the manganese is finely powdered, the reaction takes place with incandescence, but the fluoride formed is partly volatilised and decomposed, so that the product is not of constant composition. Manganous fluoride is also attacked by fluorine, but the reaction is never complete, whilst with manganous chloride it is difficult to expel the whole of the chlorine. With manganous iodide, however, the reaction is much more regular, and manganese trifluoride, Mn_2F_6, is obtained in crystals which preserve the form of those of the iodide from which it was derived, and have sp. gr. 3·54. When heated, it decomposes with the production of manganous fluoride and fluorine, whilst it is reduced by hydrogen below a red heat, hydrogen fluoride and manganous fluoride being formed. At the ordinary temperature, chlorine, bromine, and iodine are without action on manganese trifluoride, but on heating, ternary compounds are formed, that with iodine being of a red colour.

When the trifluoride is heated in glass, the latter is violently attacked, silicon fluoride being liberated, whilst a mixture of fluoride and oxyfluoride of manganese remains.

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trifluoride, forming dark brown solutions which are decomposed by excess of water. The action of water alone results in the formation of manganous fluoride, hydrofluoric acid, and a hydrated oxide of manganese, the relative proportions of these products depending on the amount of water employed. Manganese trifluoride readily reacts with hydrogen sulphide, sulphur chloride, and sulphuryl chloride, whilst with phosphorus trichloride it yields phosphorus fluorochloride, PF_3Cl_2, and with phosphorus pentachloride the pentafluoride.

With carbon tetrachloride, the products obtained are a white manganese fluoride, chlorine, and carbon fluoride.

Organic substances, such as benzene, turpentine, chloroform, alcohol, and ether, are without action on manganese trifluoride, even at 100°.

PHYSIOGRAPHY.

(STAGES 2 AND 3.)

ENERGY—(*continued*).

The Mechanical Equivalent of Heat—(*continued*).

Dr. Joule was the first to make a determination of the mechanical equivalent of heat with any approach to accuracy. The apparatus which he used consisted of a copper vessel or calorimeter which had a number of projecting vanes attached to its inner surface. Along the axis of the vessel, and supported on suitable bearings, was a vertical spindle carrying a number of vanes arranged so as to pass between the fixed vanes on the walls of the vessel. The vessel was filled with water, which was churned up when the spindle was caused to rotate. The fixed vane prevented the water being freely urged round and round the vessel. The vanes on the spindle, of course, imparted energy to the water, but the latter continually struck against the fixed vanes. The energy of motion was thus converted into heat. This, of course, raised the temperature of the vessel and the water. The success of the experiment depended upon the accuracy with which the amount of energy imparted by the rotating vanes to the water and the amount of heat produced from it could be measured.

In order to ascertain the energy used, Joule adopted the following method.

The spindle carrying the movable vanes was prolonged through the lid of the calorimeter. On it was a wooden bobbin, around which two strings were coiled. The strings were arranged so that they could be both unwound at the same time from opposite sides of the bobbin. One end of each string passed from the bobbin over a light pulley and supported a weight. When the weights were allowed to fall towards the ground, they caused the spindle and vanes to rotate and churn up the water. By multiplying the mass of the weights in pounds by the distance in feet through which they fell, Joule obtained in foot-pounds the amount of work which they performed. By lifting up the weights and letting them fall a number of times, he was able to raise the temperature of the water by an appreciable amount. Multiplying the weight of water plus the water equivalent of the calorimeter by the rise in temperature, he obtained in heat units the quantity of heat produced, and was thus able to calculate the amount of work necessary to produce one unit of heat. This figure we have already spoken of as the *Mechanical Equivalent of Heat*. It is also frequently spoken of as *Joule's Equivalent*, and is represented by the letter "J," the first letter of Joule's name.

A number of corrections had to be made in order to get a reliable figure for J. The chief of these were the following:—

(1) Correction for the kinetic energy which the weights still possessed just before they reached the floor. This energy was converted into heat in the weights and in the floor, and was not given to the calorimeter. This, then, had to be ascertained by determining the velocity of the weights just before they reached the floor. Call this velocity v. The energy lost was then $\frac{1}{2}mv^2$ where m was the mass of the weights. This was subtracted from the work done, calculated as above.

(2) Correction for heat lost due to friction in the pulleys.

(3) Correction for the heat lost by the calorimeter during the experiment.

There were several drawbacks to Joule's experiments in determining the mechanical equivalent of heat, the chief one of which was that the total rise in temperature was small, being less than half a degree. The rise in temperature was read on a thermometer reading to $\frac{1}{100}$ of a degree centigrade. This thermometer, again, was not compared with a standard air thermometer to ensure its correctness.

The figure obtained by Joule for the mechanical equivalent was 772 foot-pounds—that is, to raise one pound of water one degree Fahrenheit.

In order to improve on Joule's result, Professor Rowland modified Joule's apparatus in the following way.

The calorimeter was attached by strings passing through its upper rim to a disc carried at the lower end of a vertical rod. The rod was suspended by its upper end by a wire. Near the upper end of the rod was a horizontal grooved pulley. Two silk cords were wound round this, and left it tangentially at the opposite ends of a diameter and passed over pulleys. To the ends of the cords weights were attached. The weights, if allowed to fall, would therefore turn the calorimeter round. Passing up through the bottom of the calorimeter was a vertical spindle carrying vanes, arranged so as to pass between the vanes on the internal walls of the calorimeter. This spindle could be rotated by means of bevel wheels. It also carried a revolution counter, so that the number of revolutions could be read off.

The spindle with its vanes was rotated by machinery, and the speed could therefore be kept fairly constant. The water then tended to rotate and carry the calorimeter round with it. It was prevented from doing so by means of the weights, which tended to rotate it in the opposite direction.

The advantages of this form of apparatus were:—

(1) The weights were not allowed to fall, and therefore there was no correction to make for loss of energy on impact with the floor, and no correction for friction was necessary.

(2) A considerable rise in temperature could be obtained, a rise of nearly one degree per minute being registered.

Into the method of working out the result we will go next month.

THE BOARD OF HYGIENE AND TEMPERANCE AND NATIONAL TEACHING.

In reply to a memorial signed by members of the Board of Hygiene and Temperance and others interested in the scientific and systematic teaching of these subjects as one of the direct preventives of physical deterioration, the President of the Board of Education replied very favourably on 12th June, and subsequently inserted the two subjects in the curriculum of the Code.

He states:

"You may be sure that I cordially sympathise with any efforts which may be made to encourage the practical teaching of these subjects in our elementary schools. The Board have already shown their appreciation of the value of such teaching by themselves issuing a syllabus of instruction. Further I am now considering the possibility of making some mention of the subject in the forthcoming Code.

"I am convinced that such teaching should as far as possible be given by the ordinary members of the school staff, and I accordingly am inclined to look favourably upon any arrangements which it may be found possible to make for providing teachers with the requisite knowledge. The question of surcharge is one for the auditor, and not for myself, but I do not anticipate any difficulty under this head, provided that the expenditure can be said to have been made with the object of improving the teaching qualifications of the teachers."

The Board of Hygiene and Temperance is arranging special courses of training to provide experts for teaching and lecturing. The first series will be held weekly in the Laboratory of the Birkbeck College, Breams Buildings, Chancery Lane, during the Michaelmas Term 1906, opening Friday, 5th October, from 2.30 to 4.30 P.M. One hour's lecture followed by one hour's laboratory work will be given.

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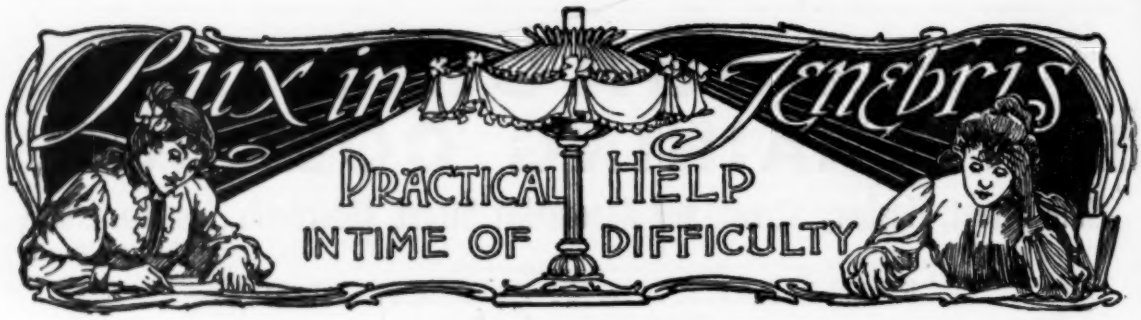

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Una.—Solve the following simultaneous equation:—

$$x+y+z=a+b+c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

$$(b-c)x+(c-a)y+(a-b)z=0 \quad . \quad . \quad . \quad . \quad . \quad (2)$$

$$c(x-a)+a(y-b)+b(z-c)=0 \quad . \quad . \quad . \quad . \quad . \quad (3)$$

It is clear from inspection that the values $x=a$, $y=b$, $z=c$, satisfy equations (1) and (3).

Writing these values of x, y, and z in (2), the right-hand side of the equation becomes

$$(b-c)a+(c-a)b+(a-b)c.$$

This expression may be written

$$ab-ca+bc-ab+ac-bc,$$

the value of which is obviously zero.

Hence each of the three given equations is satisfied by the values

$$x=a,\ y=b,\ z=c.$$

Spes.—Inscribe in a given triangle a triangle which shall be similar to another given triangle and have a given area.

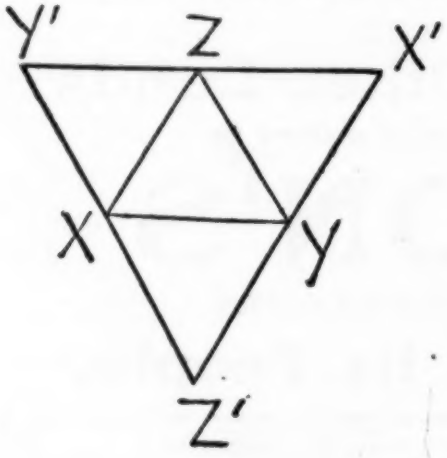

FIG. 1.

Let P and ABC be two given triangles and Q the given area; and let it be required to inscribe in the triangle ABC a triangle similar to the triangle P and equal to the area Q.

By Euclid VI. 25 describe the triangle XYZ similar to the triangle P and equal to the area Q.

By a well-known problem we can describe through the points X, Y, Z a triangle X'Y'Z' which shall be equal to the triangle ABC in every respect.

In BC take BA' equal to Y'Z; in BA take BC' equal to Y'X; and in AC take B'C equal to X'Y. Join A'B', B'C', C'A'. Then A'B'C' is the triangle required.

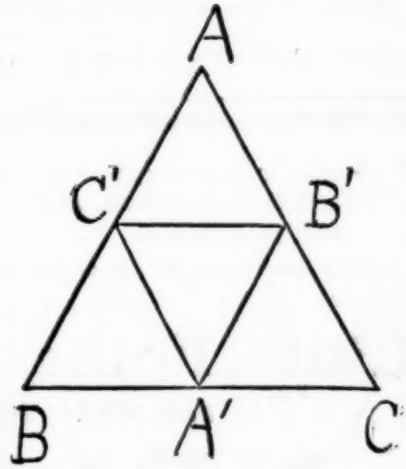

FIG. 2.

Because A'B is equal to Y'Z, and BC' to XY' and the angle A'BC' to the angle XY'Z; therefore A'C' is equal to XZ.

Similarly A'B' is equal to YZ, and B'C' to XY. Hence the triangle A'B'C' is equal to the triangle XYZ in every respect.

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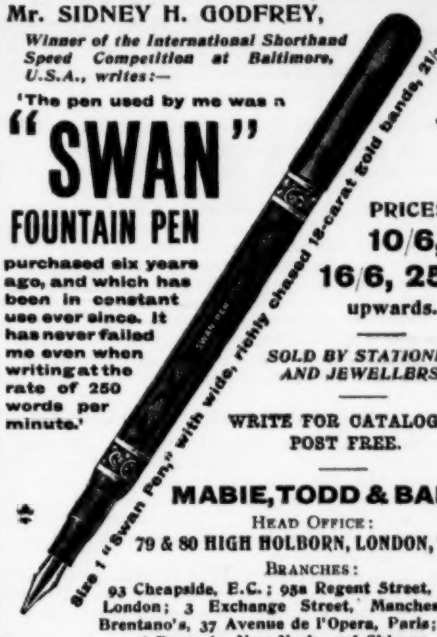

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The Seven Fold Gifts. By Wolseley Lewis. This is an exceedingly helpful little book, intended for those about to be prepared for confirmation. It is fresh in treatment and devotional in spirit throughout, and the instructions and prayers will prove of great value to candidates.

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Voice-Production and the Phonetics of Declamation. By J. C. Newlands, Lecturer on Elocution, New College, Edinburgh. Mr. Newlands is evidently a master of his subject, and has written a capital text-book for students who may be under the guidance of a capable teacher; but whether the book would, as the author hopes, be of much use to the unaided student is open to doubt. Among other puzzling directions, the student is told to breathe by allowing the diaphragm to flatten while the abdomen is kept steady, to vocalise *without emitting breath during vocalisation*, etc. In discussing the vowels the author uses a system of marks to show the various vowel values, but he gives no key as to the meaning of the marks, and we are told that "O̊" is a diphthong made up of "Ŏ" and "O͞O." This may be very true, but how is the poor student to distinguish "O̊" from "Ŏ" unless he be told the meaning of the various signs >, ∨, etc.? Among the good points of the book are its straightforward directions as to the importance of keeping the upper part of the chest *raised* and the mouth well open during vocalisation. The chapters on articulation are also admirable.

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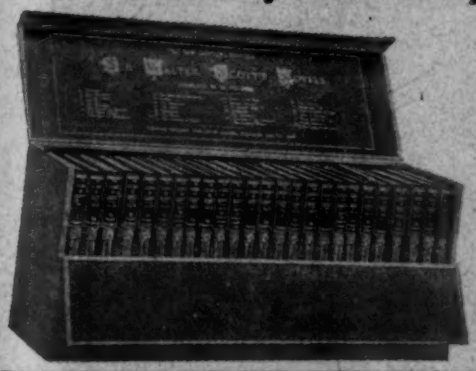

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